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POETRY.

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THE CHILDREN'S BED-TIME.

THE clock strikes seven in the hall,
The curfew of the children's day,
That calls each little pattering foot
From dance and song and livelong play;
Their day that in our wider light
Floats like a silver day-moon white,
Nor in our darkness sinks to rest,
But sets within a golden west.

Ah, tender hour that sends a drift
Of children's kisses through the house,
And cuckoo-notes of sweet "Good night,"
That thoughts of heaven and home arouse;
And a soft stir to sense and heart,
As when the bee and blossom part;
And little feet that patter slower,
Like the last droppings of the shower.

And in the children's rooms aloft
What blossom shapes do gaily slip
Their dainty sheaths, and rosy run
From clasping hand and kissing lip,
A naked sweetness to the eye, —
Blossom and babe and butterfly
In witching one, so dear a sight!
An ecstasy of life and light.

And, ah, what lovely witcheries
Bestrew the floor! an empty sock,
By vanished dance and song left loose
As dead birds' throats; a tiny smock
That, sure, upon some meadow grew,
And drank the heaven-sweet rains; a shoe
Scarce bigger than an acorn cup;
Frocks that seem flowery meads cut up.

Then lily-drest in angel-white
To mother's knee they trooping come,
The soft palms fold like kissing shells,
And they and we go singing home, —
Their bright heads bowed and worshipping,
As though some glory of the spring,
Some daffodil that mocks the day,
Should fold his golden palms and pray.

The gates of Paradise swing wide
A moment's space in soft accord,
And those dread angels, Life and Death,
A moment vail the flaming sword,
As o'er this weary world forlorn
From Eden's secret heart is borne
That breath of Paradise most fair,
Which mothers call "the children's prayer."

Ah, deep pathetic mystery!
The world's great woe unconscious hung,
A rain-drop on a blossom's lip;
White innocence that woos our wrong,
And Love divine that looks again,
Unconscious of the cross and pain,
From sweet child-eyes, and in that child
Sad earth and heaven reconciled.

Then kissed, on beds we lay them down,
As fragrant-white as clover'd sod,
And all the upper floors grow hushed
With children's sleep, and dews of God.
And as our stars their beams do hide,
The stars of twilight, opening wide,
Take up the heavenly tale at even,
And light us on to God and heaven.

JANE ELLICE HOPKINS.

Macmillan's Magazine.

A SONG OF SUMMER.

"Always in your darkest hours strive to remember your brightest." — J. P. RICHTER.

SING me a song of Summer,
For my heart is wintry sad,
That glorious, bright new-comer,
Who makes all nature glad!
Sing me a song of Summer,
That the dark from the bright may borrow,
And the part in the radiant whole of things
May drown its little sorrow!

Sing me a song of Summer,
When God walks forth in light,
And spreads his glowing mantle
O'er the blank and the grey of the night;
And where he comes, his quickening touch
Revives the insensate dead,
And the numbed and frozen pulse of things
Beats music to his tread.

Sing me a song of Summer,
With his banners of golden bloom,
That glorious, bright new-comer,
Who bears bleak winter's doom!
With banners of gold and of silver,
And wings of rosy display,
And verdurous power in his path,
When he comes in the pride of the May.

When he comes with his genial sweep
O'er the barren and bare of the scene,
And makes the stiff earth to wave
With an ocean of undulant green;
With flourish of leafy expansion,
And boast of luxuriant bloom,
And the revel of life as it triumphs
O'er the dust and decay of the tomb.

Sing me a song of Summer;
O God! what a glorious thing
Is the march of this mighty new-comer
With splendour of joy on his wing!
When he quickens the pulse of creation,
And maketh all feebleness strong,
Till it spread into blossoms of beauty,
And burst into pæans of song!

Sing me a song of Summer!
Though my heart be wintry and sad,
The thought of this blessed new-comer
Shall foster the germ of the glad.
'Neath the veil of my grief let me cherish
The joy that shall rush into day,
When the bane of the winter shall perish
In the pride and the power of the May.

Good Words. JOHN STUART BLACKIE.

From The Contemporary Review.

OCEAN-CIRCULATION.

RESEARCHES IN THE "CHALLENGER" AND "TUSCARORA."

ONE of the principal objects of the "Challenger" expedition was to bring to the test of more extended observation the doctrine of a general oceanic circulation, sustained by difference of temperature alone, which had been suggested by the temperature-observations made in the previous "Porcupine" expeditions along the border of the Atlantic basin and in the Mediterranean. Of these observations, and of the conclusions I drew from them, I gave an account in the pages of this review four years ago (vol. xvi. p. 581); and I now propose to sum up the additions to our knowledge of the subject, which have since been made by the researches of the "Challenger" in the North and South Atlantic, in the Southern Indian and Antarctic Oceans, and among the islands of the Eastern Archipelago, — supplementing this by the information obtained by the United States ship "Tuscarora" in the North Pacific, as to which more complete information will doubtless be furnished by the "Challenger," which has been at work there since leaving Japan in the spring of the present year.

It may be well for me to call to the recollection of my readers what was the state of scientific knowledge (or, as it now proves, of scientific ignorance) as regards the thermal condition of the deep sea, at the time when (in 1868) Professor Wyville Thomson and I explored the channel, of from five hundred to six hundred fathoms' depth, between the north of Scotland and the Faroe Islands.

The doctrine at that time current was, that whatever may be the temperature of the *surface* of the sea — this being dependent on the temperature of the air above it, except when the transporting action of a current brings a body either of warmer or of cooler water from a hotter or a cooler area — the temperature at any considerable depth is everywhere 39°; the thermometer progressively *falling* to that point from a surface-temperature of 75° or 80° as it sinks in the Equatorial sea, whilst it progressively *rises* to that point when sunk in either Polar ocean, after passing through the glacial surface-layer. And it was further believed that, between the Polar and the Equatorial seas, there is an isothermal band, in which the temperature of the ocean is 39° from the surface to the bottom. This doctrine appears to have originated with the French circumnavigator D'Urville; it was accepted by Sir James Ross, who supported it by the thermometric observations made during his Antarctic voyage; and, having received the stamp of Sir John Herschel's authority, it came to be generally adopted by physical geographers, not only in this country, but elsewhere — the lower temperatures occasionally recorded as having been obtained in deep soundings, being attributed to local "Polar currents."

The promulgators and advocates of this doctrine appear to have supposed that the action of Polar cold upon sea-water would be the same as that of an ordinary winter's frost upon the water of a pond or lake; first cooling down the whole of it to 39°, which is the temperature of greatest density of *fresh* water, and then cooling down the surface-layer alone until it freezes, this layer continuing to float upon the warmer water beneath, in virtue of the reduction of its specific gravity produced by its expansion as it cools from 39° to 32°. But it was long ago shown by Marcet, and afterwards more exactly by Despretz, that *sea*-water continues to contract, and therefore to become heavier (bulk for bulk) as its temperature is reduced from 39° to its freezing-point at 27° or lower. And it necessarily follows from this fact, that the water of a *closed* Polar sea, when acted on by atmospheric cold, will have its temperature reduced below 30° Fahr., from its surface to its bottom; each surface-film becoming heavier as it is cooled, and descending until it meets with water as cold as itself. If, however, the Polar sea, instead of being closed, communicate with the general oceanic basin, it may be predicated as a physical necessity, that as the weight or *downward* pressure of a column of Polar water exceeds that of a column of Temperate or of Equatorial water of equal height, and as its *lateral* pressure has a corresponding excess in proportion to its

depth, there must be a continual outflow of the deeper stratum of Polar water along the floor of any great ocean-basin accessible to it, towards the part where the elevation of temperature makes the column the lightest; whilst it might also be predicated that the reduction of level which this outflow will be always tending to produce, will occasion a surface indraught into the Polar area, which can only be fed by a general movement of the upper stratum from the Equatorial portion of the basin. The warm water thus drawn into each Polar area, when subjected to the influence of atmospheric cold, will descend in its turn, and flow towards the Equator; and the two Polar flows, meeting at or near the Line, will there tend to rise to the surface, to replace the upper stratum which has been draughted off from the Equatorial zone towards either Pole, and will be thus brought under the heating influence of the tropical sun.

Thus, I argued, a continual *vertical circulation* must be maintained in any great ocean-basin which ranges from the Equatorial zone to either Polar area; the constant opposition of temperature maintaining an as constant disturbance of equilibrium, so as to keep in continual though very slow movement (a "creeping flow" being the term I have applied to it) both the upper and the under strata of oceanic water. The *primum mobile* of this circulation I maintained to be the *surface-cold* of the Polar area, which occasions an increase of density in the whole column of water beneath, giving it a constant tendency to *descend;* its motor power being the exact parallel of that of the *bottom-heat* of the furnace which maintains a circulation of warm water through our large public buildings, conservatories, etc., by producing a reduction of density in the column of water above it, and thus giving it a continual tendency to *ascend.* The continuity of movement, in each case, is kept up by the subjection of the water which has been thus heated or cooled to the opposite influence elsewhere. Thus the water that rises from the top of the boiler through the pipes of a hot-water apparatus, gives up its excess of heat to the air of the building through which it circulates; and, in virtue of the increase of density it acquires in cooling, flows down through the return pipes, which bring it back into the lower part of the boiler, there to be again heated and sent upwards. So, in the great ocean-basins, the glacial water which descends in the Arctic and Antarctic basins under the influence of Polar cold, tends to rise towards the surface wherever the weight of the superincumbent column is diminished by the elevation of its temperature; and so soon as it comes under the influence of solar heat, it forms part of the upper flow whose poleward movement brings it again under the influence of surface-cold. Such a vertical circulation may be experimentally kept up, as I formerly described (vol. xvi. p. 594), in a long trough, by the application of cold to the surface-water at one end, and of heat to the surface-water at the other; and the only objection that can be brought against the demonstrative value of this experiment, is based on the asserted inadequacy of the force thus generated to put in motion the vast mass of water that intervenes between the Polar areas and the Equatorial zone.* This objection, however, assumes that a persistent disturbance of equilibrium can exist in the waters of an oceanic basin, without any movement to restore it, — an assertion which can be no more justified than the assertion that a persistent difference of level can be maintained without any movement to equalize it. No mathematical physicist that I have met with (and I have placed the question before several of the very highest authorities, both in this country and on the Continent) would take upon himself to affirm that the "viscosity" of water is sufficient to prevent such movements; all that it can do being to retard them. And as the astronomer royal, in his presidential address to the Royal Society in 1872, characterized the doctrine I had advocated as "certain in theory, and supported by observation," while Sir John Herschel (in a letter he was good enough to write to me within a few weeks of his

* This argument has been persistently urged by Mr. Croll, who attributes every movement of ocean-water — whether deep or superficial — to the action of winds on its surface.

death) fully accepted it as "the common sense of the matter," and as Sir William Thomson, at successive meetings of the British Association, has expressed his entire concurrence in my views, their authority has enabled me to present them with a confidence which my own comparative ignorance of physical science would have otherwise made ridiculous.

Never having claimed for myself any merit as the original propounder of the doctrine of a general oceanic circulation sustained by difference of temperature — what I considered myself to have done for the strengthening and completion of that doctrine being to show that Polar cold, rather than Equatorial heat, is the *primum mobile* — it was with nothing but satisfaction that I learned about a year ago from Professor Prestwich (who has made a special study of the literature of this subject) that nearly thirty years ago Professor Lenz, of St. Petersburg, one of the most eminent physicists of his time, had advanced the very same doctrine, in terms almost identical with my own, as an *inevitable deduction* from the facts ascertained by the series of observations on the temperature and specific gravity of oceanic water at various depths, which he had himself made in the second circumnavigatory voyage of Kotzebue during the years 1823–6. It is a remarkable proof of his sagacity, that when preparing for this voyage, he made (in conjunction with Professor Parrot) a series of experiments on the influence of pressure on self-registering thermometers, of the same kind as those which were carried on nearly fifty years later under the direction of the late Professor W. A. Miller and myself; and that, having been thus led to a complete distrust of their indications, he devised a method of obtaining deep-sea temperatures, which, though laborious and complicated, proved in his hands so satisfactory, that I find his results in singular conformity with those obtained by the use of "protected" thermometers in the "Challenger" expedition. Although Lenz published these observations (with corrective computations) in an elaborate memoir in the Transactions of the St. Petersburg Academy soon after his return, he did not then base on them any general doctrine; and the observations themselves appear to have excited but little interest. It was not until after the promulgation of D'Urville's doctrine of a uniform deep-sea temperature of 39°, that Lenz gave publicity to the conclusions to which he had himself been led by his previous observations, whose validity he justly maintained to be superior to that of the ordinary thermometric observations taken by D'Urville. These conclusions, contained in a short paper which appeared in the Bulletin of St. Petersburg Academy for 1847, are as follows: —

1. That the coldness of the bottom-water of the great ocean-basins indicates the existence of a general underflow of glacial water from the Polar areas towards the Equator.

2. That the existence, at and near the Equator, of a band of water beneath the surface, which is *colder* than the water at similar depths between the Tropics (as shown by the *rise* of the bathymetrical isotherms in passing from either Tropic towards the Equator), can only be accounted for by *a continual ascent of Polar water from the bottom;* such an ascent being further indicated by the moderation of the surface-temperature of the Equatorial oceans, and by the low salinity of Equatorial surface-water as compared with that of tropical surface-water.

3. That a movement of the upper stratum of oceanic water from the Equatorial region towards either Pole, is the necessary complement of the under-flow of Polar water.

4. That this double movement is maintained by the constantly renewed disturbance of equilibrium produced in the water of the great oceanic basins by Polar cold and Equatorial heat.

That a doctrine so distinctly propounded by a physicist of Lenz's eminence should have attracted so little notice at the time, and should afterwards have been so completely forgotten, is not a little curious; more especially as it seems to have fallen under the notice of Arago, who has been shown by Professor Prestwich to have rightly apprehended the reason of the marked contrast between the thermal condition of the Mediterranean and that of

the outside Atlantic, to which I drew attention in my former paper. The thermal phenomena of this great inland sea, indeed, afford such a valuable series of data for the interpretation of those of the great oceanic basins, and of portions of them which are partially secluded from the general circulation, that it will be advantageous to revert to them, before proceeding to discuss the additions which the "Challenger" has made to our knowledge of the latter.

The basin of the Mediterranean — except between Sicily and the coast of North Africa, where an elevation of from one thousand to one thousand five hundred feet would establish a continuity of land — may almost compare in depth with that of the Atlantic; ranging downwards to one thousand six hundred fathoms (nearly ten thousand feet) between Sardinia and the Balearic Islands, and to two thousand fathoms (twelve thousand feet) between Malta and Crete. Although it communicates with the Atlantic by the Strait of Gibraltar, yet the shallowness of the ridge or marine watershed (nowhere more than two hundred fathoms beneath the surface) which divides the two basins at the western embouchure of that strait, between Capes Trafalgar and Spartel, cuts off communication between all but their superficial strata, the temperature of which, as we shall presently see, depends upon seasonal influences common to both. And thus, as the thermal condition of the vast body of water which occupies the basin of the Mediterranean beneath that plane, must depend upon influences affecting itself alone, we have a definite basis for estimating the influence of the general oceanic circulation in modifying the temperature of the corresponding strata of the Atlantic under the same parallels of latitude.

The careful observations of M. Aimé on the temperature of the Mediterranean, which (published in 1845 *) seem to have attracted very little attention, showed that while *diurnal* variations of temperature are limited to a very thin stratum, *seasonal* variations have a deeper range; but that this likewise is limited to the upper plane, scarcely extending to more than one hundred fathoms, beneath which depth the temperature is not only *uniform all the year round*, but is *uniform from above downwards to the very bottom of the basin*. My own inquiries, carried on during the months of August, September, and October, fully confirmed the latter fact; and, being made with "protected" thermometers, enabled me to obtain a more exact determination of the temperature at the greater depths than had been previously possible. I found that in the western basin, between the surface and a depth of about fifty fathoms, the temperature fell rapidly from 77° to 57° or less; that there was then a slow reduction down to 55·5° at one hundred fathoms; and that from that depth to the bottom at sixteen hundred fathoms there was not a difference of above half a degree, the bottom-temperature being about 55°. In the eastern basin, to which the inquiries of M. Aimé had not been extended, I found the influence of solar radiation extending deeper; the reduction being from 79° at the surface to 59·5° at one hundred fathoms, to 58·5° at two hundred fathoms, and to 57° at three hundred fathoms, below which the temperature was not reduced by even half a degree to the bottom at nearly two thousand fathoms. This difference between the eastern and the western basins seemed to be accounted for by the more powerful insolation which the former receives, in virtue of its nearer proximity to the Equator, the latitude of its axis being from 3° to 4° lower.

Thus, then, we are enabled by the thermal condition of the Mediterranean, to establish it as a fundamental fact, that depth *per se* has no influence in reducing oceanic temperature; the direct influence of the solar rays * only extending to from one to two hundred fathoms; while complete exclusion from that influence is compatible with the maintenance of a constant temperature of from 55° to 56.5°. The condition which essentially determines that temperature † may be inferred from the fact, that in

* *Annales de Chimie*, tom. xv.

* I do not myself attribute the heating of the superficial stratum so much to the direct penetration of the solar rays, as to a *downward convection* arising from the increase of salinity which the surface-films undergo by evaporation, and their consequent descent until their excess of salt has been diffused through the subjacent stratum. How far down this convection may extend, will depend upon a good many conditions — most of all upon the *continuity* of the action of heat upon the surface. Where, as in the Mediterranean, it is interrupted by seasonal change of temperature, which makes the cooling of the surface-layer in winter undo all that the superheating in summer has accomplished, its downward range is probably far more limited than it is in the inter-tropical zone, in which the surface-temperature constantly approaches and often exceeds 80°. And with the example of the Red Sea before us, it can scarcely be doubted that if any of the partially enclosed seas of the Eastern Archipelago (p. 7) were to be completely shut in, its whole body of water would *in time* acquire by continuous downward convection the lowest mean of its surface.

† I was, in the first instance, inclined to regard the uniform temperature of the Mediterranean as determined by that of the subjacent crust of the earth, which

winter the uniform standard which prevails from the surface to the bottom, corresponds to the *isocheimal*, or mean winter isotherm, of the locality; and that a similar correspondence exists in the Red Sea, where the temperature in winter is as high as 70° or 71° from the surface to the bottom, and the temperature of the deeper water remains at that standard through the whole year, though that of the surface rises in August and September to 96°, or even occasionally to above 100°. And thus we seem justified in affirming, that if a portion of any great oceanic area could be in like manner so completely cut off from communication with the rest, that its temperature should entirely depend upon its own local conditions, while the temperature of its superficial stratum would be subject to seasonal variation between the highest summer mean and the lowest winter mean of the locality, that of the whole mass of water beneath this stratum would be uniform to the bottom, and would be that of the *isocheimal* of the latitude, — that is to say, of the coldest water that can find its way downwards from above.

It is important, on several grounds, to bear in mind the far greater potency of atmospheric cold than of solar heat, in their respective actions on the temperature of the great mass of salt water occupying a deep basin. Take, for instance, that of the southern portion of the Caspian, over which the winter temperature ranges from 40° to 35°, while the summer temperature ranges from 75° to 80°. For in winter the successive descent of films of water made heavier by surface-cold, exerts its full effect in bringing down the temperature, not only of the upper superheated stratum, but of the whole mass of water beneath, to the isocheimal standard; whilst in summer the heating effect of a very powerful insolation is mainly expended in producing surface-evaporation, scarcely raising the temperature of the sub-surface layer. And it is further to be remarked that the same effect would be produced if only a small portion of the basin were exposed to continuous intense cold; for while the diffusion of the successively descending cold films through the entire mass of deeper water, would tend to produce a constant reduction of its temperature, that tendency would not be antagonized by the play of solar heat on the remaining surface of the basin, the influence of that heat being limited to a very shallow stratum. We shall find a very striking exemplification of this principle, when we come to consider (p. 16) the thermal condition of the North Pacific; its enormously deep basin being nearly filled with water of almost glacial temperature, whilst even in the latitude of the Bay of Biscay we find but a mere film of water having a temperature above 35°.

It seems to me, therefore, that in the interpretation of the phenomena of ocean-temperature, we may fairly assume that any water which is *colder* than the atmospheric isocheimal of the locality, must have come into it from a source nearer one of the Poles; whilst water which carries down to any considerable depth a temperature *warmer* than the isocheimal, must have brought that temperature from a source nearer the Equator. Thus when, in the neighbourhood of the Faroe Islands, whose atmospheric isocheimal is 37° Fahr., we found the bottom of the "cold area" to be covered by water of from 32° to 29·5°, we seem justified in concluding that this water must have come from the Arctic basin; whilst, when we found in the "warm area" the stratum between two and six hundred fathoms showing a temperature of from 47° to 43°, we seem equally justified in concluding that this excess of warmth could not be derived from local insolation, but must have been brought from a southern source by the movement of a stratum having at least this thickness.

This *importation* of a foreign temperature is made peculiarly obvious, by the occurrence of cases in which marine areas are separated from the general oceanic basin, not (like the Mediterranean and the Red Sea) in such a manner as to produce a complete thermal isolation, but at such depths as to seclude the deeper strata alone; which then show a constant temperature from the plane of seclusion down to the bottom, instead of the continuous reduction which presents itself outside. Of such cases the "Challenger" has now collected several in the Indian Archipelago, the bottom of whose area presents most extraordinary local depressions, often separated by intervening ridges; these irregularities having probably been caused

there is reason to regard as, in that locality, about 54°. But I am assured by Sir William Thomson that we may throw out the temperature of the earth's crust as a factor in modifying the temperature of the water which overlies it; the exchange of heat or of cold between the solid and the liquid being so excessively slow, as not to have any appreciable effect in countervailing other influences; such as either the horizontal flow of warmer or of colder water from a distance, or the vertical descent of water chilled by the action of cold on its surface. And it is obvious from the much higher elevation of the uniform temperature of the Red Sea, in accordance with its higher isocheimal, that the correspondence between the uniform temperature of the Mediterranean and that of the subjacent crust of the earth is a mere coincidence.

by the volcanic disturbances of which this area has been one of the chief modern theatres. Thus, while the bottom-temperature of the Indian Ocean on one side, and that of the Pacific on the other, go down to 35°, or lower, the bottom-temperature of the Celebez Sea, whose depth is twenty-six hundred fathoms, does not sink below 38·5°. But as this temperature is encountered at a depth of seven hundred fathoms, and no further reduction shows itself through the whole subjacent range of nineteen hundred fathoms, it is obvious that the water below 38·5° which occupies the deeper parts of the two oceanic basins just named, must be excluded from the Celebez sea by a ridge lying at about seven hundred fathoms' depth. So in the Banda Sea there is a uniform temperature of 37.5° from a depth of nine hundred fathoms to the bottom at twenty-eight hundred fathoms; showing the depth of the ridge which excludes any inflow of colder water from the outside to be about nine hundred fathoms. In the Sulu Sea (vol. xxii. p. 389), the seclusion is much more complete; for we here find a uniform temperature of 50·5° ranging from four hundred fathoms down to the bottom at twenty-five hundred and fifty fathoms; and as this temperature is met with in the adjoining China and Celebez Seas, at a depth of two hundred fathoms or less, and in the Pacific at about two hundred and thirty fathoms, we may pretty confidently affirm that no deeper opening can exist in the reefs and ridges, which are known to connect the islands that enclose this remarkable "pot-hole," whereby colder water could find admission to it. Now let us suppose that an elevatory movement were to bring these reefs and ridges to the sea-level, so as completely to cut off the Sulu enclosure from communication with the adjacent basins; it may be pretty certainly affirmed that its lowest surface-temperature (which is probably not much below 80°) would, in time, extend itself uniformly downwards (p. 6, note), even to its greatest depths. But, on the other hand, a subsidence which should increase the depth of the barrier by three hundred fathoms, would let in water of 40° from the China Sea, and would thus reduce to that standard the temperature of the whole twenty-three hundred and fifty fathoms' column from five hundred fathoms to the bottom, which would then be deepened to twenty-eight hundred and fifty.

When, by the consideration of cases of this kind, we have once familiarized ourselves with the notion that every deep-sea temperature which does not correspond with the isocheimal of the locality (except, of course in the Polar areas, where the isocheimal is far below the freezing point of salt water), must be an imported one, we can at once apply the rule to the results of the "Challenger" or other temperature-soundings, so as to trace out the source from which the warmer or the colder water has been derived; and in this manner we can bring to the sure test of observation the general doctrine already set forth, which, if true, must be confirmed, and, if false, must be set aside by it.

The first part of the "Challenger's" survey was prosecuted in the *Atlantic* basin, which was traversed in various directions, between about 38° N. lat. and 38° S. lat., so as to obtain, by a sufficient number of "serial temperature-soundings,"* the materials for a set of "temperature-sections," which show the thermal stratification of the oceanic water, in the same manner as geological sections show the disposition of the rock-beds of which the earth's solid crust is made up. The division of differently coloured bands, in temperature-sections, is made by "bathymetrical isotherms"—that is, by lines of uniform temperature drawn at the depths at which those temperatures are respectively met with; these lines are drawn at intervals of 5° Fahr. down to 40°, below which the slowness of the further reduction of temperature makes it desirable to mark each single degree by a line. The bathymetrical isotherm of 40°, in fact, seems generally to mark a very distinct plane of division between the upper stratum, whose temperature is directly or indirectly affected by heat from above, and that of the vast mass of water occupying the deeper part of the great ocean-basins, whose temperature is reduced by the afflux of Polar water. And we shall find the position of this isotherm in different localities, and the relative number and thickness of the 5° bands that lie above it, to afford a very significant clue to those great movements of ocean-water, on which its thermal stratification depends.

The Atlantic area, which has been thus surveyed by the "Challenger," may be roughly estimated at *fifteen millions of*

* By a "serial temperature-sounding" is meant the determination of the temperature, by thermometers sent down with the sounding-apparatus, at successive increments of depth from the surface to the bottom; the intervals being usually of 100 fathoms from 100 to 1,500 fathoms, and of 250 fathoms below that depth.

square miles, with an average depth of *fifteen thousand feet;* and it is not too much to affirm that the determination of the thermal stratification of this vast mass of oceanic water is the grandest single contribution yet made to terrestrial physics. The plan of the voyage did not permit the continuous extension of the Atlantic survey either southwards or northwards; but it was afterwards carried from the Southern Indian Ocean (whose thermal condition closely resembles that of the South Atlantic) into the Antarctic areas; and the "Valorous," which has accompanied the "Alert" and the "Discovery" to Disco Island, is even now (if all has gone well) prosecuting similar inquiries, as complemental to those of the "Challenger," on her return voyage down Baffin's Bay and across the northernmost extension of the Atlantic; while the return of the "Challenger" in the early part of next year, round Cape Horn, will enable her to run another line of section through the Atlantic, nearly north and south, during her homeward voyage.

The basin of the Atlantic is a vast area of depression, of an average depth of from two thousand to two thousand five hundred fathoms; showing few abrupt inequalities, save where local volcanic outbursts have thrown up islands, and raised the bottom in their neighbourhood, as has been the case with the Azores, Madeiras, Canaries, and Cape Verde Islands in the north, and with St. Helena, Tristan d'Acunha, and Fernando Noronha in the south. This basin is in perfectly free communication with the Antarctic area; and it is a point to be specially noticed, that there is a continual widening of the borders of the South Atlantic towards that area, by the recession of the opposite coasts of the South-African and South-American continents. With the Arctic area, on the other hand, its communication is far less free. The basin of the North Atlantic progressively narrows from the Equator to the Arctic circle; and of the channels which lie between its American and its European borders, there is reason to believe that the passage between Greenland and Iceland is the only one which can bring down any large body of glacial water from the Arctic basin.

These differences between the relations of the North and of the South Atlantic to their respective Polar areas, will be found, as I had anticipated, to be in remarkable correspondence with differences in their thermal conditions. For I had ventured to predict that the Antarctic under-flow would be so much more voluminous than the Arctic, as to reduce the bottom-temperature of the South Atlantic below the 35°, which was the lowest that had been met with in the Temperate portion of the North Atlantic; while I had further anticipated, on the same grounds, that the effect of the Antarctic under-flow would show itself to the north of the Equator. The meeting of the two under-flows in the Equatorial region, beneath an upper stratum whose elevation of temperature would reduce its specific gravity, appeared to me (in ignorance of what Lenz had long previously urged), to necessitate the uprising of Polar water from the bottom towards the heating surface, just as in the trough experiment; so that, however anomalous it may seem, I had been led by the principle I had adopted to conclude that water of 40° would be found in the Equatorial zone at a depth considerably less than that at which it lies in the Temperate portion of the North Atlantic. As it is universally admitted in science that nothing affords stronger evidence of the truth of any doctrine which cannot be directly demonstrated, than the fulfilment of predictions based upon it, the complete verification of the foregoing conclusions by the "Challenger" observations can scarcely be regarded in any other light than as a valid confirmation of the principle on which they were based.

The first line of temperature-section taken by the "Challenger," extending obliquely across the North Atlantic, from Teneriffe (lat. 28° 5m. N.) to St. Thomas's (lat. 18·5° N.), shows a thermal stratification which is, on the whole, very uniform; the whole of the deeper part of the basin, from one thousand fathoms to the bottom (which lies in some parts at a depth exceeding three thousand fathoms), being occupied by water whose temperature ranges downwards from 40° to 35·5°; while, between the surface and five hundred fathoms, the reduction of temperature is pretty uniform, becoming slower between five hundred and one thousand fathoms as the isotherm of 40° is approached. But a careful examination of the section reveals two remarkable phenomena—(1) that as the Equator was approached the bottom-temperature became *lower* by about a degree, the thermometer showing 34·4° in the deepest part of the western basin, against 35·5° in the deepest part of the eastern; and (2) that the isotherm of 40°, which lies at a depth of between nine hundred and one thousand

fathoms near Teneriffe, came *nearer the surface* by about two hundred fathoms towards St. Thomas's, although the temperature of the superincumbent strata showed a considerable elevation. The reduction of bottom-temperature was afterwards clearly proved to be consequent upon the extension of the colder Antarctic under-flow to the north of the Equator; while the approach of the 40° isotherm towards the surface, as the elevation of the temperature of the upper stratum reduced its downward pressure, was interesting as an anticipation of what subsequently showed itself in a far more marked degree.

The "Challenger" then proceeded from St. Thomas's to Bermuda, thence in the course of the Gulf Stream towards New York, thence to Halifax, and thence back to Bermuda. The following were the points of greatest interest in this part of the survey. Soon after leaving St. Thomas's, a local depression was encountered of the (then) unprecedented depth of 3,875 fathoms, or 23,250 feet, or nearly 4 1-2 miles. The sounding was a very satisfactory one; and a proof of its exceeding depth was furnished by the crushing of the "protected" thermometers, which had previously resisted the pressure of nearly four tons on the square inch encountered at 3,150 fathoms.

In contrast to this curious phenomenon, the "Challenger" soundings in the immediate proximity of the Bermuda group demonstrated the very small base from which the wonderful column arises, whose summit forms a platform of which the islands are the highest elevations. The shape of this column, which has a height of more than twenty-four hundred fathoms, may be compared to that of the Eddystone lighthouse. Its upper part is entirely composed of coral; but there are curious magnetic indications of its being based on a submarine mountain; and it seems to be the most remarkable case of which we have at present any knowledge, of that progressive upward growth of coral, keeping pace with progressive subsidence of the bottom, which Mr. Darwin was the first to suggest as the explanation of the existence of dead coral at depths far greater than those at which the reef-building corals can live.

As the "Challenger" proceeded northwards from St. Thomas's out of the reach of the Antarctic under-flow, the bottom-temperature rose to 35°, and afterwards, in proceeding towards New York, to 35.3°; but as she neared Halifax, the bottom obviously came under the direct influence of the Arctic under-flow; for its temperature there fell to 34-3°.

This bottom-temperature was encountered beneath the Gulf Stream itself, which, notwithstanding the attributes which have been somewhat poetically ascribed to it, looks, as prosaically pictured in the "Challenger" temperature-sections, a mere rivulet in comparison with the oceanic area over which it is reputed to exert its heating and propulsive influence. It is perfectly clear from these sections, that the *true* Gulf Stream, or Florida current, is a limited river of superheated water, of which the breadth is about sixty miles near Sandy Hook, whilst near Halifax it has separated into divergent streams forming a sort of delta. Its depth (as determined by the use of the current-drag) was nowhere found to be greater than one hundred fathoms; and it does not disturb the stratification of the subjacent layers, which show the ordinary progressive reduction, the isotherm of 40° here lying at the depth of about six hundred and forty fathoms. Clearly, therefore, it is utterly incapable of impelling the enormous mass of water which can be shown, in the North Atlantic, to be slowly moving in a north-easterly direction towards the Polar area. The course of the surface-isotherms laid down by Dr. Petermann, shows that this movement takes in the whole breadth of the North Atlantic, from Newfoundland to the British Isles, a distance of seventeen hundred miles; on the other hand, the course of the bathymetrical isotherms laid down from the "Porcupine" temperature-soundings between Lisbon and the Faroe Islands shows that it extends to a depth of at least five or six hundred fathoms. And thus we are required to believe that the Gulf Stream, which, according to the most trustworthy authorities, has lost every distinctive character as a current — warmth, movement, and colour — by the time it reaches the Mid-Atlantic in 40° N. lat. and 30° W. long., has still energy enough to drive polewards a mass of water seventeen hundred miles wide, and at least three thousand feet deep. This, as it seems to me, is a sort of *reductio ad absurdum* of the doctrine which attributes the amelioration of our climate, and the keeping open of the harbours of the coast of Norway, almost as far as the North Cape, through the whole winter, to the heating influence of the Florida current. For if the stream shown in the New York section subsequently spread itself out over the whole area that

is shown by the northerly bend of the surface-isotherms to have a poleward movement, it must thin away to a degree that will leave it utterly incapable of resisting the cooling influence of the air above it. If, on the other hand, it is re-collected in a sort of *cul de sac*, and so pressed downwards as to acquire five or six times the depth it has off New York, it cannot propel a band of seventeen hundred miles' breadth.

When, on the other hand, we look upon the poleward movement of the entire upper stratum of the Atlantic as the necessary complement of the glacial under-flow from the Arctic basin, the main difficulty vanishes; every fact is accounted for by an adequate *vera causa;* and we can estimate the share of the Gulf Stream in the amelioration of our climate by a judgment based on actual facts, instead of indulging in vague hypotheses or poetical exaggerations.

There can be no question that a large part of the heat which the Gulf Stream brings as far as the banks of Newfoundland, is there dissipated by its encounter with the Greenland and Labrador current, which, propelled by northerly winds, brings southwards a temperature as much below the normal as that of the Gulf Stream is above it. Further, in the spring and early summer, this current ordinarily brings down a vast quantity of icebergs, whilst occasionally (as in the season just passed) it is also loaded with field-ice. Partially dipping under the Gulf Stream, in virtue of its greater density, it drifts these icebergs into its course; and since the mass of each berg that is below the surface is eight or nine times as great as that which towers above it, the melting of a vast number of such masses will require an amount of heat, the abstraction of which must further seriously reduce the temperature of the Gulf Stream. What excess it still carries is communicated to the Mid-Atlantic water, with which it soon afterwards becomes indistinguishably mingled; and in so far as the temperature of the upper oceanic stratum is raised by such admixture, does the Gulf Stream contribute, by the poleward movement of this stratum, to produce the effect with the whole of which it is popularly credited.

Only a portion of the Arctic current, however, dips under the Gulf Stream. Its main body keeps close to the shore of Newfoundland, turns the corner of Nova Scotia, passes across to Cape Cod, and "hugs the shore" of the Atlantic seaboard of the United States, remaining still perceptible as a current (at certain times, at least) as far south as New York. But this is not all. A continuation of this "cold band" is traceable southwards, intervening between the United States' coast and the Gulf Stream, as far south as the Florida Channel itself, of whose breadth it occupies nearly one-third; the plane of separation between this band and the Gulf Stream being so well defined, as to be termed by the United States' coast surveyors the "cold wall." Though they have traced its continuity with the cold stratum lying beneath the Gulf Stream, they have obviously been puzzled to account for its presence; since it shows little or no current-movement to the south of New York. The "Challenger" section taken off Halifax presents a yet more remarkable example of that continuity than any that had been previously met with; for we there see not only the bathymetrical isotherms of 55°, 50°, 45°, and 40°, sloping upwards towards the coast-line, so as to rise successively to the surface from depths of 400, 470, 550, and 620 fathoms respectively, the surface-water becoming colder and colder as the shore is approached; but even the isotherms of 39°, 38°, 37°, 36°, and 35° rise from the depths beneath, so that water of an almost glacial temperature is found outside the harbour of Halifax (lat. 44·5° N.) at a depth of no more than eighty-three fathoms. The meaning of this very singular fact I shall now endeavour to explain.

Much ink has been wasted in the discussion of a question, which the common sense of any one who rightly apprehends the fundamental principles of physics should enable him to answer at once — viz., the influence of the earth's rotation upon the movement of the water which fills its ocean-basins. This influence, supposing that water to be otherwise stationary, will be simply *nil;* for the water lying under each parallel will have the same rate of rotation from west to east, as the solid earth in that parallel. But suppose that a large body of water has a movement of its own, either from a lower to a higher, or from a higher to a lower parallel; it will then, according to a well-known principle of physics, carry with it the easterly momentum of the parallel it has quitted, into a parallel which has a different rate of eastward movement; and thus, if flowing from a lower to a higher latitude, it will carry with it an excess of easterly momentum which will cause it to tend constantly towards the east; whilst, if flowing from a higher to a lower latitude,

it will arrive at the latter with a deficiency of easterly momentum, causing it to be (as it were) left behind, so as to tend constantly towards the west. Now, the excess of easterly momentum possessed by the Gulf Stream, in virtue of its northerly flow, was rightly assigned by Captain Maury, and accepted by Sir John Herschel, as a principal cause of its eastward change of direction where the parallels of latitude are rapidly shortening; and I apply the same principle to explain the very strong eastward tendency of the poleward upper-flow, which carries it not only to the shores of Norway, but past the North Cape towards Nova Zembla. But if this be true, the converse also will be true in regard to any southward movement of Arctic water; and thus we see not only why the continuation of the Greenland and Labrador current should have a westerly tendency which keeps it close to the shore of the United States, but also why the glacial under-flow should approach the surface along the coast-line. For if this under-flow has a constant movement, however slow, towards the Equator, it must carry with it a deficiency of easterly momentum, which will cause it to creep up the slope that forms the western border of the Atlantic basin; and thus the upward slant of the deep, cold strata in this situation becomes an evidentiary fact of singular cogency, in favour of the actual existence of that southward movement which has been shown to be probable on *à priori* grounds — no other way of accounting for that slant being discernible.

It is a fact of no little interest, that, as I learn from Dr. Meyer of Kiel, who has made a special study of the temperature of the North Sea, a similar peculiarity presents itself near our own shores. The greater part of that sea is so shallow, that an elevation of no more than three hundred feet would convert it into dry land, uniting the eastern coast of Great Britain to continental Europe. But outside the coast of Norway there is a much deeper channel, along which there flows southwards a cold stream which can be traced as far as the Skager Rack; and this, under the influence of its deficiency of easterly momentum, flows up the western slope of that channel, and spreads itself over the floor of the North Sea as far as the Dogger Bank, on the eastern slope of which Dr. Meyer has found a sudden reduction of no less than fifteen degrees of temperature, in a vertical descent of no more than five fathoms. This extension of the Norwegian cold understratum affords the *rationale* of the remarkable fact previously ascertained by the dredgings of Mr. J. Gwyn Jeffreys — viz., the presence of Arctic mollusks on the Dogger Bank; and it further explains the low sea-temperature of our eastern coasts, which had been previously attributed (like the "cold band" along the Atlantic seaboard of the Southern States) to a surface-current from the north, of which in neither case is there any evidence.

Returning now to the "Challenger," we trace her course back from Halifax to Bermuda, and thence again across the Atlantic to the Azores and Madeira. The principal features of interest in this temperature-section are the great thickness of the upper stratum above the isotherm of 40°, which lies at a depth of about nine hundred fathoms between the Azores and Madeira; and the special thickness, in the western half of this section, of the stratum between 60° and 65° Fahr. We shall be better prepared to understand the meaning of these peculiarities, when we compare the thermal stratification of the North with that of the South Atlantic.

From Madeira, the course of the "Challenger" was turned southwards, in a direction of general parallelism to the western coast of Africa, until she approached the Equator; and we now encounter a remarkable change in the thermal stratification. For, whilst the surface-temperature progressively rose from 71° to 79°, this augmentation affected the superficial stratum alone; the isotherm of 60° remained parallel to the surface; but all the subjacent isotherms were found to *slant upwards*, that of 40° rising from nine hundred and fifty fathoms half-way between Madeira and St. Vincent to six hundred and fifty fathoms off St. Vincent, and to four hundred and fifty fathoms in 3° N. lat., — thus confirming in a most remarkable manner the conclusion of Lenz, that the Polar under-flow rises towards the surface in the Equatorial zone.

The "Challenger" then crossed the Atlantic for the third time between 3° N. lat. and 4° S. lat., passing St. Paul's Rock and Fernando Noronha, and thence proceeding to Pernambuco, lat. 7·5° S. The facts brought to light in this part of her survey may be considered as surpassing in interest all that had been previously ascertained; their confirmation of the doctrine she was directed to test being of crucial value. For in the temperature-section here obtained, these two features are specially noticeable — first, the further reduction of bottom-temperature, and, second,

the yet nearer approach of the isotherm of 40° to the surface. Almost precisely under the Line, a bottom-temperature of 32·4° was obtained at a depth of 2,475 fathoms; and as the isotherm of 35° (the lowest temperature that the Arctic underflow could here bear) lay at the depth of about eighteen hundred fathoms, it is obvious that the stratum of 675 fathoms (4,050 feet) in thickness beneath this, must entirely consist of water that has found its way thither from the Antarctic area. But this is overlaid by a stratum of fifteen hundred fathoms' thickness, whose temperature ranges between 35° and 40°; thus actually carrying up the isotherm of 40° to within three hundred fathoms of the surface. From 78° at the surface, the thermometer was found to fall to 55° within one hundred fathoms, just as it does in the Mediterranean; but whilst in that inland sea the temperature remains constant from that point to the bottom, it goes on falling, beneath the Equatorial sun, to 45° at about two hundred and twenty fathoms, to 40° at less than three hundred, and thence progressively to the bottom-temperature of 32·4° through a stratum of more than two thousand fathoms' thickness. Now, as the lowest surface-temperature of the whole year cannot be here less than 75°, it is clear that the influence of what may be called "imported cold" ranges from the bottom, where it is most intense, up to the superficial stratum, gradually dying out as the water comes under the influence of the downward convection (p. 6, note) of the heat imparted by solar radiation. And it seems impossible to account for this fact in any other way, than by attributing it to a continual uprising of colder water from below, to replace the warm upper layer which is constantly being draughted off towards either Pole. If that uprising were slower than it is, the downward convection of the heat derived from solar radiation would prevent the effect of Polar cold from showing itself so near the surface; and there would be no such extraordinary thinning-away of the upper strata, as shows itself in this Equatorial section.

Another evidence of this uprising is afforded by the moderation of the surface-temperature of the Equatorial Atlantic, which does not seem to rise (at least in the open ocean) to a higher average, even when the sun is vertical, than I have myself seen it to maintain in the Mediterranean during August and September. In the Red Sea, where there is no such ascent of an under-stratum of cold water, the mean temperature of the surface in August is 86·5°, and in September 88°; and the maximum not unfrequently rises to 100°, occasionally to 106°. Now, as it is not the heat of the air that thus raises the surface-temperature, but direct solar radiation, I can see no other reason why the temperature of the Equatorial Atlantic does not rise as high as that of the Red Sea, than that the former is kept down by the continual ascent of cooler water. Where such an ascent is prevented by the comparative shallowness of the bottom (as happens along the Guinea coast), the surface-temperature rises.

Another strong indication of this ascent is afforded by the specific-gravity observations, very carefully and systematically made by the physicist of the "Challenger." It was long since observed by Humboldt, that whilst the salinity of oceanic surface-water increases as either Tropic is approached from its Temperate zone, it diminishes again on passing from either Tropic towards the Equator; and this fact was confirmed by the observations of Lenz, on whom it obviously made a great impression. The progressive increase between the Poles and the Tropics is obviously referrible to increased evaporation; but what is the cause of the Equatorial reduction? To attribute it to the admixture of the fresh water which descends in Equatorial rains seems absurd; because all this water, and more, has been pumped up by evaporation from the Equatorial area itself. And the quantity of fresh water discharged by the great rivers of Africa and South America is utterly inadequate to produce such a reduction, which is as distinct in mid-ocean as it is nearer either of these continents. The true explanation is afforded, as Lenz pointed out, and as, in ignorance of his work, I had myself suggested, by the ascent of the Polar underflow; which brings all the way to the Equator the low salinity it has derived in the Polar areas from the melting of ice and snow. This reduction of salinity not being sufficient to neutralize the increase of specific gravity produced by reduction of temperature, the Polar water continues to underlie the more saline water above it; but rising to the surface as the latter is draughted off, it continues to show its Polar source by its low specific gravity, even when its temperature has been raised to the Equatorial standard. A mean of eight observations between St. Thomas's and Bermuda gave 1·0272 as the specific gravity of (tropical) surface-water, and 1·0263 as

that of (Polar) bottom-water.* But a mean of seventeen observations between Cape Verde and Bahia gave 1·0263 as the specific gravity of (Equatorial) surface-water, while a mean of eight observations gave 1·0261 as the specific gravity of (Polar) bottom-water,—an approximation so remarkable, that it can scarcely be considered as capable of any other explanation, than that the Equatorial surface-water is really Polar water which has risen up from beneath.

Proceeding southwards along the coast of South America as far as Abrolhos Island, lat. 20° S., the "Challenger" then crossed the South Atlantic to the Cape of Good Hope; first stretching obliquely to the island of Tristan d'Acunha in lat. 38°, and then keeping in nearly the same parallel to the Cape. Though the depth of this basin is less than that of the North Atlantic, the general temperature of its bottom was found to be about two degrees lower, averaging 33°, while the isotherm of 35° lay at about six hundred fathoms above the bottom; thus showing the existence of a stratum of water of one thousand eight hundred feet in thickness, colder than any that is found (save under exceptional circumstances) in the North Atlantic. The isotherm of 40°, again, which, in the North Atlantic at a like distance from the Equator, lay at eight hundred or nine hundred fathoms' depth, here lay at between three hundred and five hundred fathoms; thus showing that the whole mass of water filling the South-Atlantic basin beneath that depth has been subjected to the influence of Antarctic cold. Though the stratum above the isotherm of 40° is thicker than under the Equator, it is only about half as thick as the corresponding stratum in the North Atlantic, and contains much less heat; the surface-temperature in this section nowhere rising above 60°, and being generally much lower, though taken in the early summer of the southern hemisphere.

The thermal condition of the South Atlantic, then, differs from that of the North Atlantic—(1) in the greater coldness of the vast mass of water occupying the deeper part of its basin; and (2) in the inferior warmth of its upper stratum. The former is clearly attributable to the complete freedom of communication between the South Atlantic and the Antarctic area; the latter is probably due to several influences in combination, as I shall now explain.

In the first place, as has long been known to physical geographers, the great predominance of land in the northern hemisphere raises its general temperature; the solar radiation raising the temperature of the land, whilst it expends itself, when falling on the surface of the sea, in increased evaporation. Hence the *thermal* Equator lies to the north of the *geographical* Equator; and the isotherm which corresponds to the parallel of (say) 30° south, lies in the Northern hemisphere nearer the parallel of 40°.

But, secondly, the peculiar direction of the American coast-line gives a northerly slant to by far the larger proportion of the great Equatorial drift-current of the Atlantic. Too much attention, as it seems to me, has been fixed on the part of it which is impelled into the Gulf of Mexico, and which issues forth from it as the Gulf Stream; and too little upon that very large part which strikes the chain of the Antilles and the peninsula of Florida and which must be thus turned back without entering the gulf. Although this drift-current is quite superficial, its depth being estimated by Captain Nares at no more than fifty fathoms, yet it seems to me quite conceivable that the vast body of water it conveys should make its way downwards, when its onward motion is checked, so as to raise the temperature of the sub-surface layer, and that this is the explanation of the marked thickness of the stratum of between 60° and 65° Fahr., which has been already noticed as a peculiar feature of the sections taken in the western portion of the North Atlantic (p. 12).

In the third place, the progressive narrowing of the North-Atlantic basin from the Equator to the Arctic circle, and the progressive widening of the basin of the South Atlantic from the Equator southwards, may be expected to exert precisely opposite influences upon the thickness of that upper stratum, which, *ex hypothesi*, is being drawn, in each hemisphere, from the Equator towards its Pole—tending, in the first case, to increase its thickness by lateral compression, and, in the second, to diminish its thickness by lateral expansion. In virtue of this excess of thickness, the north-moving stratum in the former will possess a far greater power of resisting the influence of atmospheric cold, than the south-moving stratum in the latter; and we thus find the isotherm of

* In all these observations, the *temperatures* of the samples compared were brought to a common standard, so that their respective specific gravities truly indicated their relative *salinity*.

40° lying at the depth of eight hundred fathoms even off the Faroe Islands, in lat. 59.5° N., whilst near the island of Tristan d'Acunha, in lat 38° S., it lies at only about half that depth — the surface-temperature in both situations being about 52° Fahr.

We are enabled, by this comparison, to estimate pretty nearly the relative effects of the Gulf Stream and of the general oceanic circulation, in producing that amelioration of the climate of north-western Europe, which is a fact that cannot be called in question, whatever may be our mode of accounting for it. The correspondence of the surface-temperature of the Mediterranean, which is regulated by local influences alone, with that of the outside Atlantic under the same parallels, seems to show that no excess of *surface*-heat is communicated to the latter by the transport into it of Equatorial water. But, on the other hand, the great excess of heat contained in its sub-surface stratum, over that contained in the upper stratum of the South Atlantic at a like distance from the thermal Equator, seems partly attributable to the larger share of the Equatorial current which the former receives in the two modes just alluded to. This, however, would have no effect whatever upon our climate, if the entire upper stratum had not a continual northward movement; and for this movement, extending all across the Atlantic to a depth of at least six hundred fathoms, it is impossible to account by any residual *vis a tergo* of a limited current which has completely died out by superficial expansion. But if we admit that, alike in the North and in the South Atlantic, this upper stratum is being drawn polewards by a *vis a fronte* generated by the continual descent of the water that comes under the influence of Polar cold, we see how the excess of thickness it possesses in the northern hemisphere enables it to impart to the atmosphere above it a corresponding amount of warmth. For, as every surface-film that has given up its heat to the air above it, sinking until it meets with water as cold as itself, is replaced by the uprising of warmer water from beneath, so, the further down the excess of warmth extends, the longer will it be before the temperature of the surface is reduced to that of the air above — just as the surface of a deep lake remains uncongealed by a frost which forms a thick layer of ice on a shallow pond or mere.

It was urged, several years ago, by the late Mr. Findlay, that supposing the Gulf Stream proper to have a continuous onward movement to the western shores of Great Britain, the thinness of its expansion, and the slowness of its rate, where it is last recognizable as a current, would subject it to the loss of all its surplus heat, long before it reaches our coast; and this argument is strongly confirmed by the fact, that the upper stratum of the Mediterranean, though heated by the summer sun to quite as high a temperature as that of the Gulf Stream in the mid-Atlantic, loses its excess of warmth with the seasonal reduction in the temperature of the atmosphere above it; whilst, as soon as its surface has been cooled down to the constant temperature of the deep subjacent bed, it resists any further reduction, whatever may be the temporary depression of the atmospheric temperature. And in this manner we find that the moderate, but permanent, elevation of the uniformly heated mass of Mediterranean water, has a far more potent influence in ameliorating the climate of its northern shores, than the transient superheating of its surface-layer.

But it does not hence follow that Mr. Findley was right in attributing the amelioration of the climate of north-western Europe, as Dr. Hayes has since done, solely to the heat transported by the south-westerly winds; for the very careful and systematic observations which have now been carried on for some years under the able direction of Professor Mohn, of Christiania, upon the relative temperatures of the air and the sea along the coast of Norway, have shown that the latter has an average excess of warmth during the four winter months, amounting to 14·5° Fahr. This excess he very naturally attributed, in the first instance, to the influence of the Gulf Stream; but he has latterly expressed his concurrence in my own view, that the poleward transport of this vast amount of heat requires a far larger and deeper movement, for which the general oceanic circulation alone can adequately account.

This view derives further confirmation from the extension of the "Challenger" inquiries into the Antarctic Ocean, by a southward deflection from her course between the Cape of Good Hope and Sydney. For it becomes plain, from an examination of the temperature-sections taken in this part of her voyage, that the comparative coldness of the southern oceans is essentially due, not so much to the want of a superheated surface-layer, as to the rapid reduction in the temperature of the whole comparatively thin upper warm stratum under the influence of atmospheric cold: the isotherm of 40°, which lies below four hundred fathoms in lat. 37°

S., rising to one hundred and fifty fathoms in lat. 46° S., and actually coming to the surface near Kerguelen's Land (lat. 50° S.), while it lies below eight hundred fathoms in the corresponding northern parallel. Thus it comes to pass that the summer climate of Kerguelen's Land, as Captain Nares remarks, is comparable to the winter climate of the British Isles; and that glaciers there descend from the mountains almost to the water's edge, reminding us of the ice-sheet which covered the surface of North Britain during the glacial epoch.

The "Challenger" approached the Antarctic ice-barrier in the height of the southern summer, when the influence of solar radiation was exerted in melting the icebergs and the edge of the field-ice, and thus in lowering rather than raising the temperature of the surface-water, which was found to be pretty constantly that of melting ice as far do vn as the thickness of the ice extended. This was exactly what had been anticipated; for the water thus chilled does not descend, but remains floating at the surface, in consequence of the lower proportion of salt which it contains; and yet it does not rise in temperature, because any further accession of heat it may receive from the sun is expended in melting more ice. But underneath this stratum of half-salt glacial water, there was found a stratum of ordinary sea-water having a temperature between 32° and 37°; and this was obviously continuous with the proper surface-stratum at such a distance from the ice-barrier as to be out of the reach of melting ice; whilst there was every reason to believe that the whole subjacent mass down to the bottom had a temperature of 31° or less.* Now, it is obvious that as this warmer stratum could not have derived its heat from local solar radiation, it must have brought it from elsewhere; and as there is no Gulf Stream in the southern ocean, there seems no other agency to account for its presence, than the Polar indraught which has been so frequently referred to.

Thus the observations upon ocean-temperature hitherto collected by the "Challenger," in the North, Equatorial, and South Atlantic, in the Antarctic, and in the Eastern Archipelago, not only prove conformable in every particular to the doctrine they were designed to test, but do not seem capable of any other explanation.

The temperature-observations recently made in the North Pacific by the United States' ship "Tuscarora,"—which was commissioned to carry a line of soundings for a telegraph cable across this vast ocean-basin from the coast of California to Japan, making the Sandwich Islands a half-way station,—enable us to test this doctrine by a case which presents a marked dissimilarity of conditions. For, although the North Pacific has a communication with the Arctic basin through Behring's Strait, yet this is too shallow, as well as narrow, to admit of any outflow of glacial water from the latter into the former. Now, as the average depth of the North Pacific is considerably greater than that of the North Atlantic, and as there is reason to believe that this excess extends to the South Pacific also, we should expect, on the principle already stated (p. 7), that the influence of Antarctic cold will be strongly exerted throughout the whole of it; and this is fully borne out by the "Tuscarora" observations. For the bottom-temperature, at depths exceeding two thousand fathoms, is nearly everywhere but little above 32°; while the slight elevation which was shown as the "Tuscarora" returned by a more northerly course, along the Aleutian Islands, suffices to show that this low temperature cannot depend upon the surface-cold of the local winter, but must be imported all the way from the Antarctic area. But, further, this glacial water was found to occupy the whole basin to at least as high a level as it does that of the South Atlantic; the upper stratum of above 40° Fahr. having nowhere a greater thickness than four hundred fathoms, and thinning away so rapidly towards the north, that, except in the line of the Kuro Siwo, or Japan current—which is the continuation of the Pacific Equatorial deflected to the N.E. by the continental and insular coast-line of Eastern Asia—the glacial stratum comes to within a closer proximity to the surface than it is anywhere known to do under corresponding parallels; water of 35° being met with at no more than fifteen fathoms' depth in the latitude of the Bay of Biscay.

* As the thermometers supplied to the "Challenger" only registered *maxima* and *minima*, it is obvious that the reduction of the surface-temperature to 29° prevented an exact determination of the temperature of any subjacent stratum having a *higher* minimum. The Arctic Expedition is provided with the improved thermometers devised by Negretti and Zambra, for recording the temperature of any stratum, whether higher or lower than that of the water through which they pass in their descent and ascent; and in this way it is expected that the temperature stratification *beneath the ice* will be exactly determined.

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Now, I do not hesitate to confess that the thermal condition of the North Pacific revealed by these observations, was altogether contrary to my anticipations. I had supposed that the virtual seclusion of its basin from the influence of Arctic cold, and the vast distance of its northern part from the Antarctic area, would have combined to give to its sea-bed a temperature *above* that of the other great ocean-bottoms. And no reason had occurred to me, why the surface-stratum should contain so small a measure of heat. And yet, on reasoning out the problem, I came to see that, anomalous as it may seem, the want of communication between the North Pacific and the Arctic basins, in the presence of a perfectly free communication with the Antarctic, is a reason why the upper stratum of the former should be rather colder than warmer. For we may consider the entire Pacific and Antarctic basin in the light of a long trough, at the south end of which Polar cold is applied to the surface; while Equatorial heat is applied to the surface at, say, one-third of the length of the trough from the north end. Now, in the southern division of the trough, the circulation will go on as in the former case (p. 4); the water chilled by Polar cold descending and flowing along the floor of the trough, and being replaced by the surface-inflow of warmer water from the Equatorial region. But as the Polar bottom-flow will not meet any similar flow from the opposite end of the trough, only a portion of it will rise to the surface under the Equator, the remainder continuing to flow to the northern end of the trough, thus keeping its temperature down nearly to the Antarctic standard. On the other hand, the South-Polar surface-indraught will not only extend to the Equator, but, in the absence of any corresponding indraught towards the North Pole, will act backwards (as it were) upon the upper stratum of the North Pacific, giving it a southward movement *towards* the Equator, instead of the northward movement *from* the Equator, which is so remarkable a feature of the North Atlantic. To replace this, the cold under-stratum of the North Pacific will be continually rising towards the surface; and thus the powerful action of the sun's summer heat between the parallels of 30° and 50°, will be constantly antagonized by that of the winter cold of the Antarctic area at a distance of eight thousand miles or more. But if a subsidence of the land bordering Behring's Strait were to take place to such an extent as to open a broad and deep channel between the North Pacific and the Arctic basin, the outflow of Polar water that would then go on from the latter into the former, would produce a movement of the upper stratum in the contrary direction; thus drawing a surface-flow of Equatorial water towards the Aleutian Islands, and raising the temperature of the land-border on either side.

Thus we see the great importance of this general oceanic circulation in regulating the distribution of temperature, alike at the surface and over the bottom, of those vast marine areas, which, in the aggregate, cover little less than three-fourths of the whole superficies of our globe. And it is by this distribution of temperature, that the distribution of animal life is mainly dominated. But as I showed on a former occasion (vol. xxii. p. 391), its influence in providing the inhabitants of the abyssal waters with both food and oxygen is not one whit less important; the condition of a deep inland sea (such as the Mediterranean), which is virtually cut off from its influence, being one of such stagnation, as to be incompatible with the existence of animal life at any great distance beneath the surface. There is no reason to suppose that animal life could exist on the ocean-bottom at depths far exceeding that of the barren sea-bed of the Mediterranean, if it were not for the vertical movement produced by opposition of temperature; which, by bringing up every drop of ocean-water, in its turn, from the deepest abysses to the surface, purifies it from the carbonic acid and other products of animal decomposition with which it has come to be charged, imparts to it a vivifying dose of oxygen, and mingles with it those products of vegetable life, which serve, when carried down to the ocean-depths, for the nutrition of the animals that swarm upon their bottom, and contribute, by the accumulation of their calcareous *exuviæ*, to form the components of future continents.

W. B. CARPENTER.

From Blackwood's Magazine.

THE DILEMMA.

CHAPTER XXIV.

THE residency at Mustaphabad, which was now to become the scene of an eventful episode in the history of the Great Mutiny, stood, as has already been explained, in a park of about fifty acres, sur-

rounded by a strong brick wall, stuccoed white, and about five feet high. On the east side this boundary was distant about a hundred and fifty yards from the house; and immediately within the wall, and exactly east of the main building, was Captain Sparrow's house — or, as it was generally called, the Lodge, — the wall at this point being indented, and projecting into the outer road, so that the back wall of the house was without the general line of the boundary wall. The carriage entrance was about fifty yards to the north of Sparrow's house. There was no gate here, but only an opening in the wall about twenty feet wide, whence the road led by a slight sweep up to the portico on the north side of the house; a rough barricade of carts and carriages removed from their axles had been placed in this gap. Fifty yards more to the north came the end wall of the stables, which ran along the enclosure, their back wall corresponding with it, the open front of the stalls facing the park. In continuation of the stables was the range of servants' huts, also running along the wall and extending up to the north-east corner of it. The north wall was distant about two hundred and fifty yards from the house, and three hundred yards long. The west wall met the north wall at an obtuse angle, and ran obliquely to meet the west end of the south wall, which latter was more than a quarter of a mile long, and nearly three hundred yards from the south side of the buildings. Thus three sides of the park boundary were parallel to the house, and the fourth inclined to it, — the whole enclosure forming a trapezoid, the triangular portion of which was occupied by the vegetable and fruit garden. This garden was separated from the lawn, at the distance of some fifty yards from the house, by a thick hedge. Outside the park wall on the east side ran the road from cantonments to the city, about three quarters of a mile off, traversing a plain on which stood the court-house, surrounded by a grove of scattered trees. Opposite Sparrow's house, on the other side of this road, was a village surrounded by a mud wall. On the other three sides the park was surrounded by fields, at this season bare of crops. A line of well-grown trees ran along the wall on all sides; the park itself was dotted with timber, and laid out with grass, the turf being at this season of the year as hard as the roads and of a bright red colour. The garden, on the west side of the park, was thickly planted with bushes and fruit-trees.

The building itself has already been described in general terms. It was a very large rectangular block, substantially built of brick without regard to economy in the thickness of the walls, stuccoed red outside, flat-roofed, one storey high, with the floor raised about five feet from the ground. The portico was on the north side, and from underneath it a flight of broad steps gave access to the house, the centre rooms of which consisted of an anteroom, dining-room, drawing-room, and billiard-room, leading in order from one to the other, all very lofty and spacious, and communicating by two large folding-doors in each wall. On the left or east of the landing-place was a sort of pantry and storeroom, used to heat the dishes brought from the distant cook-house before dinner; and on the right a guard-room, communicating with the top of the steps, and in which also was the staircase to the roof. Next to these four public rooms on the west side was a suite of four large rooms, used in ordinary times as the commissioner's private office and dressing-room, his wife's bedroom, her boudoir, and her maid's room, communicating with each other and with the public rooms by folding-doors. A similar suite of four rooms, one of which was used as an office and occasional dining-room, the other three being usually reserved for guests, was on the east side. Outside these two suites of rooms were wide and lofty verandas, supported on substantial pillars, extending along the east and west sides, and terminated by bathing-rooms which projected into them at the four corners. There was a similar veranda on the south, outside the billiard-room. Part of the middle of the east veranda was also occupied by bath-rooms attached to the guest-chambers. The centre rooms were somewhat higher than the outer, and were lighted when the doors were closed by rectangular clerestory windows. The outer rooms, again, were higher than the veranda, and were lighted in the same way.

South of the house, and about thirty yards from it, was the bath-house — a rectangular building containing a swimming-bath about thirty feet long by twenty broad, enclosed on all sides by a wide platform, raised a few inches above the level of the water. The roof was supported partly on pillars which ran round the edge of the bath, and externally by a wall resting on brick arches which extended round the building on the outer edge of the platform; the spaces between the arches had been filled up with a brick wall seven feet high for the sake of priva-

cy, leaving the space above open for circulation of air. The bath was supplied with water from a well adjacent to it on the south, worked ordinarily by bullocks and a Persian wheel. The platform of the bath-house was four feet above the ground, and was approached by a flight of steps on its north side, opposite the billiard-room veranda.

Such was the building which was now to be defended. Large, airy, and massive, and standing in its own grounds at a distance from other houses, one better adapted for defence could not have been found in India; and although the additional works improvised in the emergency were of a very simple kind, consisting mainly of the sandbag wall, which, as already described, had been erected round the outer edge of the verandas, the building presented a formidable obstacle against the attack of any enemy unprovided with guns. This sandbag parapet had been made seven feet high, with loopholes at a height of six feet from the ground. The portico had been enclosed in the same way, and gave a partial flanking defence to the north side of the building, while on the south side a similar advantage was more effectually given by the detached bath-house. Here no sandbag parapet was needed, the building being surrounded externally by a bullet-proof wall to the height of seven feet, in which loopholes had now been driven, while a sandbag parapet, erected on the circular rim of the well attached to the bath, brought this all-important element of the supplies within the line of defence. A trench of communication had been dug between the two buildings, the earth from which had been thrown up as a parapet on either side, but progress had been slow in the hard soil, and the trench was but a shallow one, forming imperfect cover. An opening left in the rampart of the south veranda gave access to this trench, a lane of sandbags leading to it down the steps. The landing at the top of the north flight of steps was also protected by a parapet, so as to cover the entrance to the guard and store rooms, an opening being left to give access to the portico. This completed the defenders' works, save that such of the numerous massive folding-doors as were not needed for communication about the building, and which usually stood open (privacy being secured by light hanging screens and curtains), were closed for the occasion. The strength of the building as thus set out was evidenced by the cautious manner in which the assailants had begun their attack.

The persons who had taken refuge in the building, and composed its garrison, were as follows: —

1°. Falkland, Sparrow, and two East-Indian clerks belonging to the residency office. To these must be added the American missionary, Mr. Jabez P. Hodder. This gentleman had been deaf to all the entreaties made him on the outbreak to leave the mission-house, which was in the heart of the city, and his wife had refused to leave her husband; and they had held their ground at the mission until the *émeute* in the city of the day before, when some of his native catechists had carried him and his wife away, almost by force, till they fell in with Falkland's party returning from their fruitless errand, and committed the steadfast pair to his charge.

2°. Brigadier Polwheedle, Captain Buxey, and Major Peart from the cantonment staff, and a Mr. Layton, who kept a general store in cantonments.

3°. Major Dumble and eight officers 76th N.I.

4°. Seven officers 80th N.I.

5°. Two officers 82d N.I., the survivors from the massacre of that regiment.

6°. Drs. Maxwell, residency surgeon, and Grumbull of the 76th N.I.

Total, thirty Europeans, of whom, however, the brigadier was not effective for work.

Of native combatants there were — the commissioner's jemadar, Ameer Khan, and four orderlies, and the seventeen faithful sepoys of the 76th, or twenty-two in all. Thus there were fifty-one effective combatants altogether.

Six of the commissioner's servants, including his old butler, were still present of those who had promised to stay, and one native groom had been retained in charge of the horses picketed under the portico.

The women were — Mrs. Falkland, Justine, Mrs. Polwheedle, Mrs. and Miss Peart, Mrs. Hodder, Mrs. O'Halloran, the newly-made widow of the unfortunate bazaar-sergeant, and Mrs. De Souza, the wife of one of Falkland's clerks. There were also Mrs. O'Halloran's two children. The only native female of the party was Olivia's ayah.

Altogether seventy souls were collected within the building.

Hitherto there had seemed to many of the European members of the community thus strangely collected together, a sort of

unreality in the situation. They had heard of bloodshed and massacre in other places, but so far they had gone through no experience of actual violence. Even when they escaped from the cantonments, the flight took place at night; and although firing could be heard, they had seen no enemy, and were not actually molested. Since that time, although they had been huddled together in this enforced companionship, everything without had seemed perfectly quiet, and, save for their own disordered appearance, there was no sign of outrage or rebellion. Only last evening when they were strolling round the house in the dusk, to get a breath of fresh air, the park presented a scene of perfect peace and quiet, even the ordinary traffic on the road outside being suspended. Possibly, then, to some of the party it may have seemed as if either what had taken place in other parts of the country was a horrid dream, or else that a special good-fortune attended them, and that the worst in store for themselves would be the burden of a day or two passed in this way, in discomfort and on their guard, until the expected relief should arrive. But now, as the sound of rapid firing suddenly broke out around, and the quick patter of the bullets could be heard against the walls, the truth dawned upon these poor women that no special providence would shield them from the same horrors as had overtaken so many of their friends and fellow-countrywomen. For them, too, awful moments had come, when they were called on to face battle and murder and sudden death; and some of them, as they stood trembling in the great dining-room, might well think that the enemy were upon them, and their last moment had come, as they heard the tramp of feet hurrying up the stone stairs and into the outer hall.

It was the body of the garrison returning from the outside, and who now passed by them swiftly to reinforce their respective posts, giving as they went by in their excitement a hurried word or two of encouragement.

Every man's place had been assigned to him beforehand, and within a few seconds after the re-entry of the picket, the garrison was distributed in the appointed order, awaiting the attack.

The distribution of that force had been arranged as follows: —

The main guard of six Europeans and six sepoys was established in the portico under command of Captain Braddon. Major Passey commanded the bath-house picket, consisting of four Europeans and four natives. A party of four Europeans and three natives was posted in the east veranda, under Captain Underwood, the senior officer of the 80th; and another of the same strength, under Major Peart, in the west. Dumble, Buxey, and two other Europeans, with the two doctors and five sepoys, formed a reserve to reinforce whatever part might be necessary. This reserve was stationed in the anteroom or entrance-hall.

Yorke was attached to Falkland as his staff-officer, but his post when not required in that capacity was in the western veranda; and his heart beat high with excitement as he thought that his share in the struggle was, as it were, to guard Olivia's own room.

Falkland also kept his jemadar unattached, in personal attendance on himself.

CHAPTER XXV.

THE different parties were now at their posts watching through their loopholes the fire of the enemy, which as yet had not been returned, for all that could be seen was the head and shoulders of an occasional sepoy, rising up for a moment from behind the wall to deliver his fire, and then crouching down again.

Meanwhile the ladies remained in the dining-room, where also was the brigadier on a sofa, in a state of expectancy. None of them felt as if the state of tension could last, or as if it were worth while moving from their places for the present. Thus they waited for the sound of the assault, which every moment they thought must be made. And here, surrounded by outer walls and the blockaded veranda, the firing made but little noise.

Presently there was a crash of glass from a picture-frame hanging against the wall. A bullet, aimed too high, passing over the sandbag rampart in the veranda, had come through the outer room and lodged in the dining-room wall, piercing the head of one of Landseer's stags on the way.

The ladies started up, all but Olivia, who kept her seat, though pale, and some one gave a little scream.

Just then Falkland looked into the room. "Ha," said he, "we forgot the pictures; we must have them down, or the place will be covered with broken glass. You are not frightened, my love, are you?" he said, taking the hand of Olivia, who had gone to meet him, between his own, and stroking it fondly, while he looked

down on her with a gentle smile. "You see, as long as the bullets go up here, you are in no danger."

"Not afraid, except for *you*," she replied, laying her disengaged hand on his arm, while the large eyes looked up wistfully from the pale face. "Oh, Robert dear! pray be careful of yourself; Mr. Yorke has been telling me of the risk you ran just now. I don't want to be selfish, but think how much to all of us depends on you."

"Don't be alarmed, my child," said her husband, smiling again, and patting her on the shoulder; "it was necessary to show these scoundrels that we were not afraid of them; but now that we are all safe inside, I am going to set an example of caution to everybody."

"But cannot we women be of some use? It is dreadful being made to sit here doing nothing. Cannot we help to load your rifles, or something of that sort?"

"Better keep here awhile. I am in hopes the rogues will take themselves off in an hour or two, when they see there is nothing to be got by stopping."

"Hark! what is that?" cried Olivia, starting, as a sharp crack was heard outside.

"Our fellows opening fire," said her husband. "You will soon get accustomed to the noise. I have told them only to fire, sir," he continued, addressing the brigadier, "when they see a chance of doing execution; that is in accordance with your wishes, I believe:" and so saying, he hastened away.

Strict orders had been given to the garrison to be careful of their ammunition, which was limited, and not to fire unless with a chance of doing execution, and, so far, not a shot had been returned to the continued but harmless fusilade directed at the building. Some of the mutineers, emboldened at this, had jumped over the wall and taken shelter behind the trees, thus getting a few yards nearer to the building, from which position they could aim more leisurely.

"Here is a case within the colonel's orders," said Passey, who commanded the bath-house picket, as from a loophole in that building a sepoy could be seen distinctly reloading his musket, hidden by the trunk of the tree from the main building, but exposed to view from this projecting angle. "Now, M'Intyre, you are a dead hand at an antelope running, I know; see if you can't hit a pandy standing. Here's one of old Cunningham's Westley Richards; you shall have the first shot."

The subaltern, who was standing on an empty beer-chest placed against the wall, took the rifle which Passey handed to him, and aimed through a loophole, the others watching the result through other loopholes.

M'Intyre fired; the sepoy staggered and fell.

"Well done!" cried Passey, getting on the box to look out; "you have drawn first blood. The beggars will be a little more cautious about showing themselves now, I expect."

"That rifle shoots the least thing too high," said M'Intyre, returning the weapon, and resuming his own. "I aimed at the fellow's stomach, but I think I hit him through the heart. I'll try my own, next time, major, if you please."

"Here they come on our side," said Egan to Yorke, as the two, also mounted on empty boxes, stood looking through the loopholes of the west veranda.

"I see the bushes moving, but I can't see any fellows."

"You can hear them, at any rate," said the other, as the bullets lodged in the sandbags with a thud, or, passing over their heads, rattled against the back wall of the veranda.

Indeed, the garden seemed to be now full of men, who kept up a continuous but ill-directed fire against the building.

"The fellows fight more like red Indians than respectable sepoys," observed Mr. Egan; "however, they are sure to give us a chance before long."

Presently he fired. "Look here, Yorke!" he cried; "come here if you want to see one of the noble enemy. Do you see a pair of legs just by that plantain-tree? That's all I could see; but I aimed where I thought the body must be, and the legs haven't moved since. See, they are dragging the body away. I must have another go at them," and he fired again, and the shot appeared to take effect, for the dragging operation ceased.

Thus the affair went on, a scrambling fusilade kept up by the assailants, the garrison only returning the fire when there was a fair chance of doing execution. A man climbing over the wall too deliberately, fell headlong from the top under M'Intyre's unerring aim; and the same marksman had sent a shot into a group of men standing in the direction of the courthouse, a distance of nearly four hundred yards, laying one low and dispersing the

rest. Two or three of the party which now occupied Sparrow's house had been seen to fall; Braddon, from the main picket, had shot two. Yorke, also, had made his first hit: a man moving from one bush to another, musket in hand, stooping as he went, but still exposing himself, fell prone at Yorke's fire, and crawled away slowly, and the young man felt half savage and half sick at the result of his shot. His ideal of war had been associated with taking life in the abstract only, and the first actual taste of blood, albeit of a would-be murderer's, caused a sickening sensation, which, however, soon yielded to excitement, and the love of killing inherent in mankind. And now a couple of good shots sent up to the roof did some damage before the assailants in the garden, thus laid open to view, had time to withdraw more under cover. Altogether, when Falkland went the rounds, fifteen or sixteen of the enemy had been distinctly accounted for, but no one of the garrison had been touched.

These losses made the rebels more wary. The party which had occupied the garden retired to a safe distance, and the fire on all sides sensibly abated.

"I begin to feel like grub," said Mr. Egan to his comrades, after a time. "This is an exciting if not a very dangerous occupation, and makes one peckish, not to say thirsty. I feel as if I could dispose of any quantity of pegs if they were to be had. I wonder what time it is. By Jove!" he continued, pulling out his watch —"fancy, it's only eight o'clock!" And in truth, although the garrison seemed to have been undergoing an interminable siege, the day had scarcely begun.

Shortly after this, breakfast was served —tea, hot cakes of unleavened bread (the Indian *chupattees*), and stew with rice. The pantry by the portico served as the kitchen, and for occupation by the servants, while that opposite it was appropriated to the sepoys, who cooked for themselves. The flour and grain had been stored in the north-east spare room, while the commissioner's stock of sheep and poultry had been penned in a part of the platform of the bath-house. The ladies and the reserve took their meal in the dining-room; the different guards each furnished a detail of one of their number to receive their portion, except that stationed in the bath-house, which had been supplied with a day's provisions and a native servant to cook; for the trench leading to it afforded but imperfect cover, and Falkland would allow no one, except to convey orders, to go to and fro.

Various weak points in the sand-bag parapet had been discovered, especially where it joined the round pillars of the veranda, at which points two or three bullets had found entrance. These were made good, with eager zeal, and then the garrison awaited patiently the next movement of the enemy, one member of each picket, mounted on a box, keeping a look-out through a loophole, while the others sat, arms in hand, below.

As the sun mounted into the sky, the heat became fiercer than ever. The rainy season was approaching, and the high winds of the Indian summer had ceased, but not much air could find its way through the barrier, although many of the doors were open. In ordinary times it would have been declared impossible for Europeans to support such heat without punkahs, but now it was unnoticed. The ladies fanned themselves, the gentlemen wiped their faces. All were composed, but no one discussed the future.

The heat had the good effect of quieting the enemy. Towards noon the firing ceased entirely, and the first excitement of the defenders having passed over, they began to think about rest. A fourth part of each picket were allowed to leave their post at a time, to wash and dress; of the rest, a part were allowed to sleep in turn, which they did on cots brought into the verandas, or on blankets stretched on the pavement, while the remainder kept a look-out. But none of the enemy could be seen stirring. At one o'clock dinner was supplied, flour-cakes, and stew and rice as before, with a bottle of beer between every two persons. The sepoys, going off duty by turns, cooked their single meal of coarse wheat cakes, which they devoured in silence, sitting gravely on their hams and stripped to their waist, taking afterwards a long draught of water from the separate store they had previously themselves drawn from the well, for to drink water obtained in any other way would have been pollution; and then passing round the "hubble-bubble" or simple hookah for each to take a whiff.

Then Colonel Falkland, who had hardly had a minute's rest since the outbreak, fell asleep on a couch in the drawing-room, and slept till evening, his wife sitting by him and keeping the flies off his face with a brush of peacock's feathers; while Miss Peart took the children into a side-room to prevent their disturbing him,

and made them some little rag dolls to play with — for poor Mrs. O'Halloran seemed bewildered with the situation, and sat, for the most part, fanning herself silently.

Towards evening the firing was suddenly resumed, waking Falkland and other sleepers. One of the bath-house guard had incautiously exposed himself in passing through the covered way, by standing on the edge of the trench to take a look at the situation, with the parapet scarcely covering his knees, and had drawn a fire which showed that the assailants were still in force; but it slackened after a few minutes, and then stopped.

At sunset another meal was served out.

"We have come out to see if we can get a little cool air," said Olivia, appearing with Miss Peart in the western veranda after the hasty meal was ended; for by this time the restrictions on the movements of the ladies had been tacitly abandoned, and they went about the building at pleasure: "these centre rooms are getting to be almost unbearable, and I think they are worse now than during the day, because one expects to be a little cooler in the evening."

"This veranda is hardly any better, I am afraid," said Yorke, rising from the empty beer-chest on which he had been sitting, and which did duty for a banquette, "for it has had all the afternoon sun upon it. Why not go on the top of the house for a bit, as soon as it is dark, and get some fresh air? You will be perfectly safe there, if you keep to the centre, and don't go near the edge."

"That would be nice, indeed; I will go and see if Colonel Falkland will allow it." And the ladies withdrew presently from Yorke's post, not to be seen again that evening, for the roof was found to be so cool by comparison, that Falkland had shawls and bedding taken up, and the ladies passed the night there, quite unnoticed by the enemy.

With many the coming darkness was looked forward to with dread, as the enemy might be expected to take advantage of it for a real attack; and the sense of security afforded by the strength of the position, and its easy defence during the day, was succeeded, as the shades of evening advanced, by a fear of danger from some unseen quarter. And Falkland, refreshed by sleep, went round the building at frequent intervals to see that the guards were all at their posts. When night came on, too, a supply of water had to be drawn for the next day, and carried in jars to the main building. The platform-well having been surrounded with sandbags, and thus, in fact, included in the bath-house defences, the garrison of that post could draw water unseen by the enemy at pleasure, but it could not be taken along the covered way in the daytime. The task of conveying the jars devolved on the reserve, Falkland standing the while outside the covered way, to note if any sounds could be heard indicating a night attack. But although a movement of men could be heard about Sparrow's house, both then and throughout the night, the enemy did not fire a shot, or attempt to disturb them, and hopes began to arise in the breasts of many, that the rebels meant to take themselves away.

"The fellows will be off to-morrow even if they don't go to-night," said the brigadier from his couch to every one who came near him, still bathing his eyes with a wet rag dipped in the basin of water beside him; "Falkland says they are sure to do so; and in any case, he says that relief is sure to arrive by morning. The cowardly fellows will sheer off when they see the gallant Sikhs marching down on them, I'll be bound." And indeed, in all hearts the hope was strong that the attack had ended with the first discomfiture of the mutineers; and as night wore on, those who were at liberty to take rest lay down to sleep off their anxiety, while those who were on duty remained calm and silent at their posts. No lights were allowed in the verandas; some lamps threw a dim illumination during the night over the large centre rooms.

"We are so much indebted to you, Mr. Yorke, for your happy suggestion," said Olivia, as the party were drinking tea next morning in the dining-room — a recreation in which Yorke, being off duty, was able to join; "I can't tell you what a comfortable night we passed on the roof; it was quite cool, and has completely invigorated me; and then whenever one awoke there were the stars shining overhead, and everything so peaceful, it was difficult sometimes to realize where we were. But it seemed very selfish to be lying there so comfortably, while all of you gentlemen were on the watch in the dreadful heat below."

"I am sure I could hardly sleep a wink for the hardness of the roof," said Mrs. Polwheedle; "and we pay for having been cool up there, by coming down into this dreadful close room. You people who have been here all night have no

notion how awfully stuffy it feels after the fresh air."

As Mrs. Polwheedle had slept soundly during the greater part of the afternoon, it was not surprising that her night should have been wakeful; while it did also occur to Yorke that she of all the party should have had least cause to complain of the hardness of the pavement, in respect that nature had furnished her with an ample cushion; but he did not commit this repartee to words.

The party thus assembled, sitting in a circle at one end of the drawing-room round a small table on which the tea was placed, formed a curious contrast to the surroundings; for except that the room had not been dusted, that the picture-frames were piled on the piano, and various bundles lying about, it presented the ordinary aspect of a handsomely-furnished apartment; but the occupants were a strangely-assorted group. By general consent, coats and collars had been dispensed with by the men; and with several of the community a light under-waistcoat did duty for a shirt — the supply of the latter article of dress being very limited in the garrison — and with a pair of white or flannel trousers gave the wearer the appearance of a dirty racquet-player, while incipient beards added to the general seediness of aspect. All the men had their firearms beside them, or between their knees. The ladies generally did not look to much better advantage, although Olivia had somehow managed to make herself neat before descending; and her beautiful hair, coiled in neat folds round her stately head, was in contrast to the general slovenliness of the rest. Miss Peart, indeed, had washed her face before joining the party, and was clad in a clean muslin robe of her hostess; but as she sat in a low lounging-seat drinking her tea it was evident to the company that she had given up wearing stockings for the time; while Mrs. Polwheedle had apparently discarded stays and under-garments generally, as conducive to heat and supererogatory during siege-life, and sat fanning herself in a rocking-chair, clad in a crumpled wrapper which yielded to each impress of her ample figure.

CHAPTER XXVI.

THE hope imparted to the garrison by the stillness of the night and early dawn, that their enemies might have abandoned the blockade, was dissipated with the return of daylight. The sepoy encampment was still standing pitched among the trees behind the court-house; large bodies of men were drawn up near that building, detachments from which could be seen from the look-out place on the roof to march down with a semblance of discipline to relieve the advanced pickets which lined the park walls; and about sunrise a lively fire began again, especially from the east wall and Sparrow's house, the roof of which was now discerned to be protected by a parapet of sandbags piled up during the night, in imitation of the defenders' method, while the doorways and veranda facing the park had been blocked in the same way; sandbag loopholes had also been made at various points along the top of the adjacent wall, so that the assailants were now on an equality as regards cover, and having apparently unlimited ammunition, they fired briskly, although with more care than on the previous day, evidently aiming at the loopholes of the garrison. The covered way to the bath-house was now completely commanded from the roof of Sparrow's house; and as Falkland passed along it to visit the guard there, attended by Yorke and the jemadar, the party had to run the gauntlet of a sharp fire.

"It's precious lucky, sir, there were no rifle companies among our three gallant regiments," said M'Intyre to the colonel, as a bullet, coming through a loophole from which he had just withdrawn, whizzed through the bath-house, and lodged in the wall on the other side, "or we should have a few more of these gentry."

"You're an awful dab at field-engineering and that sort of thing, Arty, I know," said Spragge, who had just entered the smaller building, bringing a bag of flour for the day's rations to his friend; "but you haven't made allowance for a fellow of my inches. Just look at this," he continued, holding up his pith helmet, in the top of which were a couple of round holes; "precious lucky my poor old nut was a little lower down, wasn't it? I don't want to give Johnny Raugh a step just yet."

"Pandy is quick to take a hint," said Falkland to his aide, "and we could not prevent their making sandbags, as long as there is any cloth left in the country. But we must try if we can't manage to control their spirits a bit." And returning to the main building, he collected about a dozen of the best shots on the east side, with orders to select each a loophole in Sparrow's house, and to aim carefully as soon as it should be occupied, and then sent Yorke to creep along the covered way, on his knees, holding up his hat on a stick

just above cover. The *ruse* succeeded perfectly. In a few seconds the hat was observed; muskets protruded from every loophole on the other side, and a sharp fire was opened on the moving object. The riflemen fired in return, and as the fire of the enemy was immediately checked, some execution might be inferred; after this manœuvre the enemy became more cautious. Towards noon the dropping fire which followed this affair slackened, and was followed by a time of perfect quiet, as on the previous day.

The second day of the siege; and it seemed as if they had been shut up for a month. To the first excitement there now succeeded the monotonous discharge of the prescribed routine. The great event was to be off duty at meal-time, so as to be able to meet the delegates from other pickets, and compare notes. The ladies had now taken on themselves the office of bringing their meals to those on duty; and Yorke and the others in the west veranda had the happiness of receiving their plates of curry and damper from Olivia's hands, which the young man would fain have kissed with gratitude as he relieved them of their burden. Seen under the aspect of this crisis, she no longer seemed to be a wife. This must be a dream, thought the young man; she is more like an angel than a being of this world; no harm can come near her; and he felt quite happy at his post.

Most of the officers bathed in the bath, two at a time, and with orders not to splash or make a noise. The billiard-table also was frequented; and some cards had been hunted up, and a party sat down to whist. But the cards curled up with the heat, and got dirty and dusty, and the game soon dropped. Moreover, Olivia, remembering that her father had left some cheroots behind him — Falkland did not smoke — had unpacked and made over the precious windfall to Buxey, who had taken charge of the commissariat; and Buxey served out two cheroots a day to each person — a No. 2 after dinner, and a No. 1 in the evening. They were very good; and never were cigars more appreciated, or smoked more completely to the end.

By tacit consent the question was avoided, how long the blockade would last, or what would be the end of it; but Buxey said there was a capital stock of provisions. No one, however, but Falkland knew what was the state of the ammunition. This was stored in an underground chamber, constructed by the architect of the residency as a retreat for the hot season, according to a mode of building not unfrequent in the early days of Anglo-Indians, but which had never been used for that purpose.

One thing especially which imparted spirit and confidence to the garrison was the bearing of the native portion of it. Falkland's determination to trust these men had been viewed by several with alarm in the beginning, lest the defence should be undermined by sudden treachery within. Captain Sparrow had been very free in his criticism to all who would listen to him on the foolhardy rashness of his chief; and Mrs. Polwheedle had tried in vain to persuade the brigadier to insist on the sepoys being kept together in the portico outside the building, instead of being distributed about it, and had spent a good deal of her time at first in watching their deportment. If a sepoy looked grave, he was meditating desertion; if he laughed — and most of them seemed now in capital spirits — he was chuckling over some plot in contemplation; a respectful bearing was set down to cringing, the crouching of the tiger before its spring; and if any one seemed more free in manner than usual, the villain was chuckling in his insolence over the prospect of having the sahibs in his power. But the most timid or suspicious could no longer withhold their confidence, on seeing how heartily their dark-coloured allies had thrown themselves into the spirit of the defence. Had the enemy been their bitterest natural foe instead of the comrades of a lifetime, they could not have shown a greater alacrity in the play of sharpshooting; the difficulty was to make them husband their ammunition. Two of the sepoys who proved to be good shots had been supplied with rifles, and Falkland's jemadar had come to be regarded as next to M'Intyre the marksman of the garrison. The six servants, too, did their duty with perfect *sang froid;* and the ayah was ready at all times to brush any lady's hair, as well as that of her mistress.

"Pandy seems to have had enough of it for the present," observed Braddon between the puffs of his cigar to the little party assembled that evening in the portico, which post he commanded; and as he spoke the silence was unbroken by any firing; nor, looking through the loopholes, was there an enemy to be seen in any direction.

"I calculate we have accounted for at least thirty of them," remarked Mr. Hodder, the missionary, who wore a black al-

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paca coat and trousers, as the symbol of his calling, but had been doing active duty as a sharpshooter, and now sat on a cot, smoking, with a repeating rifle on his knees; "say thirty, besides speculating on the parties who have not been marked down; at least as many more, I'll bet. The remainder perhaps have taken the hint and gone to their own place too."

"That still leaves two thousand nine hundred and seventy pandies unaccounted for," said Sparrow, who from the first had maintained a consistently doleful appearance, "besides all the blackguards in the city, whom the commissioner so wisely provided with arms two days ago. They won't be so easily choked off, take my word for it. This silence means some new mischief, you may depend."

"Well, sir," replied Hodder, a little sallow man with a clear eye, and a face smooth save for a small light beard, "and if they do try any of their tricks, the sooner they do it the better; I guess we are ready for them; we know a thing or two; and we shall give them a warm welcome, I expect." And Mr. Hodder tapped his repeater cheerfully, and indeed his remarks only reflected the spirits of the garrison. The ease with which the enemy had been kept at bay, and their own immunity from any loss so far, had given general confidence. Relief must come soon, and it would be easy to hold out for a long time in such a fortress as this, and against assailants so unenterprising.

As soon as it was dark the ladies again ascended to the roof, and the night passed away in perfect quiet, save that about one o'clock, as Falkland, who had got some sleep during the day, and spent the night on the alert, was going the round of the sentries, the officer who was posted in the covered way — a sentry had been stationed there each night, and the post was a favourite one, the open air being much cooler than the inside of the buildings — reported that he heard an unusual noise in the direction of the entrance-gate.

Falkland stopped to listen. There was certainly a sound as of the movement of men. He went to fetch Yorke and the jemadar, who were asleep in the west veranda, and they came back with him to the trench.

Putting their ears to the ground, they could distinctly hear the sound.

"They are doing something to the barricade," said the jemadar to his master in an undertone, in Hindustani; "shall I go and see what it is?"

For a moment Falkland hesitated. Could the man be intending treachery?

Yorke seemed to divine the colonel's thoughts, for he whispered, "May I go with him, sir?"

But Falkland at once cast the unworthy suspicion from him. And after all, if any native wanted to desert, nothing was easier at any time of the night. The man being told he might go, jumped over the low parapet, and disappeared in the darkness. In about five minutes he returned. He had been down nearly to the gateway. The barricade which closed the entrance there had been made of some carts and carriages, including Falkland's own barouche, taken off their axles and fastened together. Ameer Khan could not tell for certain what the enemy were about, but they appeared to be employed in removing it.

Then Yorke obtained leave to go down and reconnoitre. The enemy had no sentries, and were so busily engaged on their work that he got within a few yards of them without being perceived. There was no moon, but the night was not dark, and lying down he watched their proceedings for some minutes. He could just make out some figures at work, and could hear the grinding noise of something being dragged along the gravel. They were evidently removing the different obstacles which composed the barricade.

Looking round to his right the outline of Sparrow's house stood out against the sky. From where he lay it was almost in his rear; he had been so intent on watching the barricade during his advance that he had not thought about the house and its occupants, and he shuddered for the moment to think how easily he might have been seen by them, and his retreat cut off. To be killed in open fight was a fate he was ready enough to meet; but to be murdered out there, without help, and without being able to sell his life, and no one knowing what had become of him,— what a horrid fate that would be! But the place seemed perfectly quiet, and dismissing his nervous fears, the young man walked stealthily towards the building. No one was stirring, and he advanced as far as the wall of sandbags which the enemy had built up along the front of the house. This he found to be about ten feet distant from the edge of the veranda, and standing by the end of this rampart so that his body would not be distinguishable from it, he took a leisurely view of the place. The veranda seemed to be full of men, all fast asleep; others lay on the gravel path

between it and the rampart, one of them, with a calico wrapper over his head and shoulders, so close that Yorke could have kicked him with his foot. After watching the scene for a few seconds, till even in the darkness the whole grew clear, he stole back to the covered way to tell Falkland, anxiously awaiting his return, what he had seen.

From The Cornhill Magazine.

THE PLANETS PUT IN LEVERRIER'S BALANCE.

LEVERRIER has recently completed the noblest work in pure astronomy which this age has seen. Five-and-thirty years ago he began to weigh the planets of the solar system in the balance of mathematical analysis. "To-day," said he, addressing the Academy of Sciences at Paris, on December 21 last, "I have the honour to present a paper completing the *ensemble* of work the first piece of which goes back to the 16th of September, 1839." At that time he had only seven leading planets to deal with; it affords some idea of the nature of his work that the discovery of the eighth planet, Neptune, was a mere incident in the progress of his labours. Perplexed by peculiarities in the motions of one particular planet of the set he had undertaken to weigh, Leverrier quietly undertook to calculate the cause of those peculiarities, and so found Neptune. It was a matter of small moment that another great mathematician almost simultaneously accomplished the same task. With Adams the discovery of the unknown planet was the ultimate object of inquiry; with Leverrier it was a mere step in a long series of investigations. To the outside world indeed it was the achievement of all others most deserving of notice in Leverrier's work, just as the discovery of Uranus by Sir W. Herschel attracted attention which labours altogether more important both in their nature and in their results had failed to secure. Leverrier himself can hardly have so regarded the discovery of Neptune. For him, its chief interest must have resided in the confirmation of his method of procedure afforded by the discovery of a planet through the careful study of perturbations due to that planet's attraction. Such confirmation was afforded at other steps of the work. In fact, the whole series of Leverrier's labours affords perhaps the noblest illustration of the value of deduction guided by and suggesting observations since Newton's "*Principia*" first proved the superiority of that method over mere induction.*

We propose to give such a sketch of Leverrier's method and results as would alone be suited to these pages. It need hardly be said, perhaps, that his work is essentially mathematical — nay, his methods, though not belonging to the very highest developments of modern mathematics, require (even to be understood) a higher degree of mathematical skill than would be implied by mere familiarity with more recent methods in mathematics. Yet it is possible to exhibit the general principles and the results of Leverrier's work in a manner which every one can understand.

In the solar system, we see first a mighty central ruler, whose mass so enormously exceeds that of all the planets taken together, that he is capable of swaying their motions without being himself disturbed. He is not indeed quite fixed. Whatever force he exerts on any planet, precisely that same force the planet exerts on him; but then he is so massive that the pull which compels the planet to circle around the sun scarcely displaces him at all. "If he pulls the planets," says Sir John Herschel, "they pull him and each other; but such family struggles affect him but little. "*They amuse them,*" he proceeds quaintly, "*but don't disturb him.* As all the gods in the ancient mythology hung dangling from and tugging at the golden chain which linked them to the throne of Jove, but without power to draw him from his seat, so, if all the planets were in one straight line and exerting their joint attractions, the sun — leaning a little back as it were

* According to Bacon, science was to be advanced by making great collections of observations and classifying them — sorting and sifting until the grains of truth were winnowed out. No great discovery has ever been effected in this manner. The real use of observation and experiment has been found in their application to test the deductions from theories formed long before materials sufficient for Bacon's inductive method had been gathered. The question is one of fact. Theoretically, Bacon's method is perfect; it has hitherto failed in practice. Take any of the great discoveries of science, and it will be found that observations and experiments merely gathered together had no part in leading to the discovery; but that observations and experiments suggested by the deductions from theory were all-important. The moon might have been observed at Greenwich for all time without the observations leading to the discovery of gravitation. But Newton's deductions from the theory (when as yet the theory was but a guess) at once showed what observation might do; and it was by observation so made that the theory was established. In spectrum analysis a perfect heap of experiments had been collected without any useful results. Kirchhoff is led by a single observation to think of a theory, deduces certain consequences, tests these by three experiments, and the great discovery is to all intents and purposes effected.

to resist their force — would not be disturbed by a space equal to his own radius; and the fixed centre, or as an engineer would call it, the centre of gravity of our system, would still lie far within the sun's globe."

To give clearness to our conceptions, let the mass of the sun be compared with that of all the other planets taken together. If we take the earth's mass as one thousand, then the mass of the eight chief planets of the solar system is represented by about four hundred and twenty-two thousand, and the sun's mass by three hundred and fifteen millions. Thus the sun's mass exceeds that of the whole solar system nearly seven hundred and fifty times; for in such a computation the combined mass of all such bodies as the asteroids, moons, meteors, etc., counts for nothing.

We see, then, that the movements of the eight planets must necessarily be determined in the main by the sun's attractive energy. What can even Jupiter, the mightest of all the planets, do to disturb his giant neighbour Saturn from the path on which the sun, a giant so far mightier than either, would, by his attractive energy, compel the ringed planet to travel? The sun is more than a thousand times more massive than Jupiter, and though Jupiter when between the sun and Saturn is at but one-half the sun's distance, yet this nearness only quadruples the relatively small power of Jupiter, and leaves the sun's force on Saturn still two hundred and fifty times greater. Besides, Jupiter is only from time to time placed in this favourable position. Half the time he is even farther from Saturn than the sun is, and thus exerts less than a thousandth part of the sun's influence. And it need hardly be said that, if Jupiter is thus ineffective in disturbing a neighbouring planet, every other planet is still weaker to disturb its neighbours. Our earth, for instance, with a mass barely equal to one three hundred and fifteen thousandth part of the sun's, has but small power to disturb her nearest neighbours, Mars and Venus, from that steady motion on their sun-ruled orbits which they would have if the earth did not exist. Venus is still weaker in disturbing the earth and Mercury, her neighbours; Mars weaker still; and Mercury weakest of all. Nor does the gradual diminution of the planetary distances as we draw nearer to the sun at all increase the relative disturbing power of the different planets. It might seem that the contrary should be the case. For instance, the other day, when Venus was in transit she was but about twenty-four millions of miles from us, and it might seem that Venus must then have disturbed the earth, and the earth Venus, very much more effectively (in proportion to their mass) than Jupiter can disturb Saturn or Saturn Jupiter, seeing that these planets never approach within three hundred and fifty millions of miles from each other. But in reality, the effect of proximity in such cases is counterbalanced by the much greater velocity with which the nearer planets travel. It would be easy to make an exact comparison, but the calculation would be unsuited to these pages. Let it suffice to say that throughout the whole of the solar system there is no disturbance greater than that resulting from the mutual attraction of Jupiter and Saturn; and how small this attraction is, compared with the sun's influence on either planet, we have already seen.

The sun being thus placed as supreme ruler over the motions of the planets, their motions starting from any given moment as a beginning, are in the main those due to solar influences. If, instead of being in the main so ruled, they were ruled absolutely by the sun, Leverrier's great work would have had no existence, as it would have had no utility. If the planets did not act upon each other by their attractive energies, any planet might be doubled or halved in mass, and all would go on unchanged. Nay, we might substitute for the eight chief planets as many peppercorns, and still the motions of these eight bodies would remain precisely the same. Calculated for one epoch, they would have been calculated for all time. No deviations would take place from which any inferences could be drawn as to the relative mass of the eight planets; but one continuous series of orbital circlings would go on, without change, forever and ever.

But once recognize the fact that the planets disturb each other, and all this is changed. The more massive a planet is, the more potently will it disturb its neighbours. If we can tell exactly how much it does disturb its fellows, we can tell how large its mass is, compared with the earth's for example, which we may take as a convenient unit of reference. But it is clear that a planet's mass may be determined thus in many different ways. For instance, we may consider how much Venus disturbs the earth, and judge of Venus's mass in that way; or instead, we may consider how much Venus disturbs

Mercury, her next neighbour on the other side, and infer her mass in that way. We might also perhaps have an opportunity of seeing how Venus affected some unlucky comet which passed near to her, and thus obtain yet another determination of her mass. If these estimates did not agree, we should know there was something wrong either in our observations or in our calculations. We should be set on the track of some error. And it has been in this manner that science has almost invariably been set on the track of important truths. If we hunted down the error successfully, we should probably be led, not merely to correct that particular mistake, but also to discover some fact before unsuspected.

It is precisely in this way that Leverrier has dealt with the planetary motions. Taking first the seven chief planets known when his labours began, he set himself to inquire into their motions. He found before long that the tables hitherto in use did not accord rigorously with observation. Now, if every discrepancy had had a single cause, it would even then have been a work of no small labour to determine each such cause. But the great difficulty which the astronomer has to deal with in considering the planetary perturbations resides in the fact that multitudinous causes are in operation, the effects of which are intermingled. Watch the troubled surface of a storm-swept ocean, and notice how every wave differs from its fellows in one respect or another, usually in many. Suppose now that the task were assigned of analyzing the causes of these varieties of form. How difficult would the task be to distinguish one effect from another and therefore one cause from another, when so many were manifestly in operation. A sudden gust of wind blowing against the sloping side of a great wave may aid to heap up or to depress the mass of water which at the moment forms the wave, and thenceforth through many oscillations the effect of that accident will remain. A wave under observation may have been affected by many gusts, acting in various ways. Again, a wave may be increased or diminished by combining with a cross-wave belonging to another series than the first, and such causes of change may have operated over and over again. Peculiarities of the sea-bottom act to modify the shape and size of waves, and a wave observed in one place may have been affected by such peculiarities in regions many miles away from the observer's station. It will be seen, then, that though the observer might find it an easy task to give a general explanation of the sea-waves before him, he would have a task of enormous difficulty — in fact, an altogether hopeless task — if he were asked to ascertain from the varieties of form presented by the waves, the peculiarities of all the modes of disturbance operative in giving to the waves their actual forms. Somewhat similar, though not altogether hopeless, as will soon appear, is the task of the astronomer called upon to assign to their several causes, *not* the observed perturbations — *that* would correspond only to explaining the general nature of the wave-motion — but the peculiarities recognized in these perturbations, the various ways in which these differ from what may be described as their normal character.

It need scarcely be said that the motions of the earth herself have to be considered in this inquiry. We do not mean merely the motion of the earth on her orbit around the sun, but the disturbances which affect that motion. The earth herself is riding on the waves of perturbation. Her movement on these waves must be as carefully considered as her motion in her course. For not merely will that movement indicate directly the nature of those waves which particularly affect herself, but also, unless that movement is taken into account, the earth-borne observer will form an incorrect estimate of the waves by which the other vessels in sight are perturbed.

To this work, then, of determining exactly the characteristics of the earth's motion around the sun, Leverrier from the very outset of his inquiry devoted close attention. It need hardly be said that the method of dealing with the question was to observe very carefully the sun's apparent motion from day to day, for this motion precisely corresponds with the real motion of the earth. It will give some idea of the extent of Leverrier's field of research, though but a faint idea of the nature of his work therein, to mention that, in dealing only with this one part of his subject, he reviewed and discussed nine thousand distinct observations of the sun, made since Bradley's time at Greenwich, Paris, and Königsberg. The first result which attracted his attention was rather an unsatisfactory one. It is commonly supposed that the observations of the sun at those three observatories, and especially at Greenwich, have been so exceedingly precise as to leave nothing to

be desired on that score. Bessel, of Königsberg, was led to remark, many years since, with some degree of surprise, that the theory of the sun (or, which is the same thing, the theory of the earth's motion) had not made the progress which might have been expected from so many and such accurate observations. Leverrier's opinion, which must be accepted as final, owing to the enormous number of observations he has examined and his unsurpassed skill as a mathematician, is very different. "Our conclusion is," he says, "that the observations of the sun leave much to be desired, on account of systematic errors affecting them; and there is no discordance between theory and observation which cannot be attributed to errors in observing."

Yet even with observations thus imperfect, Leverrier dealt so successfully that he educed from them a noteworthy discovery. One class of disturbances affecting the earth's motion arises from the moon's disturbing influence. Its nature may be indicated by saying that in every lunar month the earth circuits around the common centre of gravity of her mass and the moon's. The diameter of this monthly orbit amounts to about six thousand miles, and as a result of this motion, she is about three thousand in advance of the centre of gravity just named when the moon is in her first quarter, and as far behind when the moon is in her third quarter. Now it is that centre of gravity which alone follows the true orbit around the sun which is attributed to the earth herself in the books. The earth no more follows that orbit than the moon does. These two bodies dance round and round each other (if we may follow Sir John Herschel in using a rather homely illustration), while the pair are swung round the mighty mass of the sun. Of course this peculiarity of the earth's real motion is reflected in the sun's apparent motion. He seems at the time of the moon's first quarter to be in advance, and at the time of her third quarter to be behind, his mean place; just as if *he* were waltzing around in a monthly orbit six thousand miles in diameter, while being also swung round in his mighty annual path with its diameter of a hundred and eighty millions of miles. But it is clear that, if we can tell how large this apparent monthly orbit looks as seen from the earth, we shall know how far off the sun is. For the real size of this orbit is a matter depending only on the earth and moon, and can be inferred independently of the sun's distance. We know, then, how large the path really is; and if we know how much the sun seems displaced in traversing it, we have in fact learned how large a space of six thousand miles looks when removed to the sun's distance. This is equivalent to determining the sun's distance. Accordingly, Leverrier, having carefully estimated the sun's apparent monthly displacements, deduced thence an estimate of the distance of the sun, and confidently informed astronomers, sixteen years ago, that their accepted estimate of the sun's distance was too large by between three and four millions of miles.

This was not the first great result which rewarded Leverrier, though we have set it first because it followed from the inquiry which formed in a sense the basis of his whole system of researches. The first noteworthy result of his labours was that mentioned at the beginning of this paper, the discovery that the system of seven great planets was incomplete, another body, as yet unseen and unknown, travelling beyond the path of Uranus, and by its attraction disturbing the movements of that planet, for sixty years regarded as the remotest member of the sun's family.

And here, as in the case of the discovery of Uranus by Sir W. Herschel, good fortune as well as mathematical insight came into play. Herschel discovered Uranus by a lucky accident, when engaged in far other work than the search for new members of the solar family. Leverrier was not quite so lucky. He deliberately cast a line into space, hoping to capture the unknown disturber of Uranus. He satisfied himself by the most careful analysis of all available observations that Uranus really is disturbed by an unknown body (and, in passing, we may remark that in this respect Leverrier's work differed from that of Adams, who assumed this particular point). How then, it may be asked, was fortune concerned? We will illustrate the matter by the waves which we have already found convenient for such purposes. Suppose that an observer engaged in analyzing a series of wave-disturbances, travelling (say) along a canal, observed some new class of effects, as, for instance, that certain waves which had long been of a particular size began to grow larger. Suppose that, struck by this, he instituted a careful series of measurements of their size, and at last satisfied himself that they had increased. He might still be utterly at a loss to conjecture a cause. But if even he conjectured a cause, as, for instance, some disturbance taking place at a part of the canal out of

his sight, he might still find it impossible to conjecture how far off that part might be. If, however, while he had satisfied himself by his wave-measurements that the waves really had increased in size, he had also satisfied himself that even during his observations the increase had reached its full extent, and had even begun to give place to a slow decrease, tending to restore the original size of the waves, he would manifestly have here an indication which might serve to tell him of the very spot where the disturbance had taken place. For example, the rate at which the waves were travelling, combined with the time elapsed since the peculiarity had been noticed, might indicate exactly how many miles away was the scene of the disturbance. Now something of this kind had happened in the case of Neptune. When astronomers were thoroughly convinced that Uranus had been perturbed, or, in effect, when Leverrier had completed his analysis (surpassing all others in completeness) of the planet's observed motions, it had also become known that the displacement had reached its maximum, and was beginning slowly to decrease. This showed astronomers that the disturbing planet had made its nearest approach to Uranus, and was now slowly drawing away. Nor let the reader wonder that this was a process requiring years to produce perceptible effects. For Uranus himself moves so slowly that he only completes his circuit in eighty-four years, and Neptune (we now know) requires more than one hundred and sixty-four and a half years; so that they come sluggishly into conjunction and pass sluggishly out of conjunction.* Only when Adams and Leverrier began to angle for the unknown planet had it become quite certain that that body had been lately in conjunction with Uranus. If these astronomers had not known when this happened within a few years either way, it would have been utterly useless for them to have sought for Neptune by mathematically analyzing the disturbance affecting the movements of Uranus. Their good fortune consisted in this, that the conjunction had opportunely occurred just when the motions of Uranus were sufficiently observed to satisfy astronomers that there was an external planet.†

Setting, however, this piece of good fortune aside, which rendered their labours possible, the actual nature of the work of Adams and Leverrier was sufficiently arduous. And though their hypothetical Neptunes moved quite differently from each other, and departed still more widely from the path of the real Neptune, yet under the actual conditions both astronomers were led, as we know, to point to a place very near to that occupied by the real Neptune at that particular time. It was as though, in the illustrative case just imagined, the observer had made some error in estimating the rate at which the wave-disturbance had travelled down the canal to his place, but yet guessed very nearly the true spot where it arose, because the time it had taken was but short; for instance, if the calculated rate were too great by half a mile per hour, but the time occupied were only twenty minutes, then he would only be in error by the sixth part of a mile. But if the time were, say, ten or twelve hours, then the error would be five or six miles. So Leverrier and Adams had their hypothetical Neptunes travelling too slowly by a quite appreciable amount; but yet, owing to the shortness of the time which had elapsed since Neptune and Uranus were in conjunction, the resulting error was very small; and, as we know, the planet was found at the first cast of the telescopic line.

In passing to the next result of Leverrier's researches, we have to turn from the outermost planets of the solar system, to Mercury, the one that, so far as is as yet known, travels nearest to the sun. The motions of Mercury have been determined with a great degree of accuracy, because Mercury often passes across the face of the sun, and can at those times be observed very exactly. Now it was found that the observed movements of this planet did not accord with those calculated. "This result," says Leverrier, quaintly enough, "naturally filled us with inquietude. Had we not allowed some error in the theory to escape us? New researches, in which every circumstance was taken

* That is, they pass slowly into and away from the position in which the sun, Uranus, and Neptune are nearly in a straight line.

† The general public, while underrating the mathematical difficulties which Adams and Leverrier had to encounter, altogether overrated the actual extent of the field over which Neptune had to be searched for. It was tolerably certain already that Uranus and Neptune had been in conjunction between 1820 and 1825. Between 1841 and 1846, then, (*i.e.* in 21 years), Uranus would have gone round a fourth of the ecliptic as viewed from the sun; and the unknown planet probably about half as far. Neptune, then, was to be looked for near the ecliptic, and about one-eighth of its circuit *behind* Uranus (both being supposed to be viewed from the sun, which, in the case of planets so distant, is much the same as viewing them from the earth). It was, in fact, tolerably certain before Adams and Leverrier began their calculations, that the unknown planet occupied a position somewhere on a known strip of the heavens not more than ten or twelve degrees long by about three degrees broad.

into account by different methods, ended only in the conclusion that the theory was correct, but that it did not agree with the observations. Long years passed, and it was only in 1859 that we succeeded in unravelling the cause of the peculiarities recognized. We found that they were all included under a simple law, and that" — a certain slight change only was needed to bring everything into order. The nature of this change was such as to indicate "the existence of cosmical matter, as yet unknown, circulating, like the planets, around the sun. The consequence," proceeds Leverrier, "is very clear. There exists in the neighbourhood of Mercury, doubtless between that planet and the sun, some matter as yet undiscovered. Does it consist of one or more small planets, or other more minute asteroids, or even of cosmical dust?* The theory tells us nothing on this point. On numerous occasions trustworthy observers have declared that they have witnessed the passage of a small planet over the sun; but nothing has been established in this matter. We cannot, however, doubt the exactness of this conclusion."

Such are Leverrier's latest utterances on this interesting question. He takes no notice, on the one hand, of the discoveries recently effected in meteoric astronomy, which demonstrate the existence of at least some matter in the sun's neighbourhood; nor, on the other, of the objections raised by Sir W. Thomson and others to the theory that large quantities of meteoric matter travel close by the sun. Nor does he speak of the singular statements made by the French doctor, Lescarbault, and once to some degree sanctioned by Leverrier himself, respecting the transit of a small black disc across the face of the sun on March 26, in the very year, 1859, when Leverrier first laid his results respecting Mercury before the scientific world. We venture to quote Leverrier's account of his visit to Lescarbault's small observatory, as abridged from the *North British Review* for August 1860, in Chambers's useful treatise, "Descriptive Astronomy." It is well worthy of examination, whether it be regarded as evidence for the new planet — so confidently believed in once, that astronomers assigned a name to it, calling it, appropriately enough, *Vulcan* — or as showing the circumstantial way in which incorrect statements are sometimes advanced: —

"On calling at the residence of the modest and unobtrusive medical practitioner, Leverrier refused to say who he was, but in the most abrupt manner, and in the most authoritative tone, began, 'It is then you, sir, who pretend to have observed a new planet, and who have committed the grave offence of keeping your observation secret for nine months. I warn you that I have come here with the intention of doing justice to your pretensions, and of demonstrating either that you have been dishonest or deceived. Tell me then unequivocally what you have seen.' The doctor then explained what he had witnessed, and entered into all the particulars regarding his discovery. On speaking of the rough method adopted to ascertain the period of the first contact, the astronomer inquired what chronometer he had been guided by, and was naturally enough somewhat surprised when the physician pulled out a huge old watch with only minute hands. It had been his faithful companion in his professional journeys, he said; but that would hardly be considered a satisfactory qualification for performing so delicate an experiment. The consequence was that Leverrier, evidently now beginning to conclude that the whole affair was an imposition or a delusion, exclaimed, with some warmth, 'What, with that old watch, showing only minutes, dare you talk of estimating seconds? My suspicions are already too well founded.' To this Lescarbault replied that he had a pendulum by which he counted seconds. This was produced, and found to consist of an ivory ball attached to a silken thread, which, being hung on a nail in the wall is made to oscillate, and is shown by the watch to beat very nearly seconds. Leverrier is now puzzled to know how the number of seconds is ascertained, as there is nothing to mark them; but Lescarbault states that with him there is no difficulty whatever in this, as he is accustomed to 'feel pulses and count their pulsations,' and can with ease carry out the same principle with the pendulum. The telescope is next inspected, and pronounced satisfactory. The astronomer then asks for the original memorandum, which, after some searching, is found, 'covered with grease and laudanum.' There is a mistake of four minutes on it when compared with the doctor's letter, detecting which, the *savant* declares that the 'observation

* We follow in general a translation of Leverrier's paper in the Monthly Notices of the Astronomical Society, not having by us the original; but verbal changes have been made, the translation being, to say the truth, in very singular language. Leverrier, for instance, is made to say that "*a* matter exists in the sun's neighbourhood," and to ask if it "consists in cosmic dust."

Detroit Young Men's Library -

has been falsified.' An error in the watch regulated by sidereal time accounts for this. Leverrier now wishes to know how the doctor managed to regulate his watch by sidereal time, and is shown the small telescope by which it is accompliished. Other questions are asked and satisfactorily answered. The doctor's rough drafts of attempts to ascertain the distance of the planet from the sun, 'from the period of four hours which is required to describe an entire diameter of that luminary, are produced, chalked on a board. Lescarbault's method, he being short of paper, was to make his calculations on a plank, and make way for fresh ones by planing them off. Not being a mathematician, it may be remarked that he had not succeeded in ascertaining the distance of the planet from the sun. The end of it all was that Leverrier became perfectly satisfied that an intra-Mercurial planet had been really observed. He congratulated the medical practitioner upon his discovery, and left with the intention of making the facts thus obtained the subject of fresh calculations.' "

This, however, was not the actual end of the matter; for news came from an astronomer in Brazil, M. Liais, that at the very time during which Lescarbault said he watched the black spot crossing the face of the sun, he (Liais) was observing the sun, and nothing of the kind could be seen, though he was employing a telescope much more powerful than the one used by the French physician. It has also been pointed out that any planet nearer to the sun than Mercury ought to be a conspicuous object during total eclipse of the sun, whereas no such object has ever been noticed. On the whole, it seems very doubtful how far the records of supposed transits can be trusted, and we seem almost compelled to adopt the opinion that the meteoric and cometic matter undoubtedly existing in the sun's neighbourhood in enormous quantities, produces the observed peculiarities in the motion of Mercury. In this case the united mass of all the meteoric matter within the orbit of Venus (not of Mercury, for Leverrier's result admits of explanation by matter lying anywhere within about twice Mercury's distance from the sun) amounts, according to Leverrier's original estimate, to about a tenth part of the mass of Venus, or exceeds considerably the mass of Mercury himself. This is not inconsistent with an exceeding tenuity of material. If the matter consists of small solid or liquid bodies, the sparseness of distribution would be very great. Suppose, for example, these bodies were of the same density as water; then together they would make a globe having about half the volume of the earth. Now, if they were scattered over a flat region shaped like a grindstone, extending all round the sun to Venus's distance, and having a thickness equal to the earth's diameter, this region would exceed the total volume of the scattered meteors no less than four hundred and thirty-five millions of times. So that, on the average, each meteor would have (wherein to disport itself free from contact or collision) a space exceeding its own volume to this enormous degree. A meteor, for example, one cubic inch in volume, would have on the average a space equal in volume to a cube twenty-one yards in length and breadth and height. But the actual space occupied by meteors within the orbit of Venus is far greater, seeing that near the sun it has a thickness (so to speak of this disc-shaped region) of many millions of miles. Supposing the matter occupying this space to be a uniform gas, it would certainly be one hundred thousand million times rarer than water, or much more than a thousand million times rarer than air.

But it will presently appear that since Leverrier made that estimate of the mass of the disturbing matter, the estimate of our earth's mass, relatively to the sun, has been increased by at least one-tenth part; and this would leave a much smaller quantity of matter to be provided by meteoric systems. There remains, however, sufficient evidence to show that the total mass of matter within the orbit of Mercury amounts, in all probability, to thousands of millions of tons.

We may remark on an objection which has been urged (first, we believe, by Sir E. Beckett, then Mr. Denison, in his fine work "Astronomy without Mathematics") to the theory that vast quantities of meteoric matter in the sun's neighbourhood supply, as it were, the fuel, or part of the fuel, by which the sun's fires are maintained. He showed that the quantity of matter necessary to produce this effect would be such that the sun would grow annually by a quantity equal to more than a twelve-millionth part (he gives exacter numbers) of the sun's actual mass; and he proceeds to show that the effect of this would be to shorten the year by nearly one twenty-five-millionth part of its length — that is, by about four seconds in three years. This would make our year shorter by about forty-seven minutes than the year in the

time of Hipparchus, and we know quite certainly that there has not been a change even of half as many seconds. He proceeds then to touch on an objection to this reasoning, in the following words:—"If the meteors were all, before their absorption within the earth's orbit, forming a sort of spherical extension of the sun, it is true that their joint attraction on the earth would be the same as after they had fallen into the sun. But I have seen no suggestion that this is so, and many meteor systems, especially the two largest that we know of, have orbits extending far beyond the earth's."

This particular objection, or rather this reply to the original objection, had been advanced by the present writer some years ago. Sir E. Beckett's answer does not seem to meet the objection. For all the meteor systems we can possibly become acquainted with (as such) are those encountered by the earth, and these form so minute a proportion of the total number (on any reasonable assumption of the probabilities) that it would be unsafe to reason from them. In fact, if we could, we might at once dismiss the meteoric theory of the sun's heat, because the two meteor systems referred to by Sir E. Beckett do not pass within many millions of miles of the sun's surface. All the evidence we have, as the present writer has shown, indicates an increase in the density of meteoric distribution as we approach the sun, this increase becoming exceedingly rapid in the sun's immediate neighbourhood. Nor does it in the least matter that a certain proportion of the meteors thus crowded near the sun at any moment are in reality moving in paths carrying them far away from the sun. So long as the movements of the complete system are such that the gathering near the sun is permanent, though the members composing it may be continually changing, the consequences would be the same, or so nearly the same as to make no appreciable difference in the observed effects.

But there is in the very results on which the meteoric theory had been based — we mean Leverrier's recognition of the existence of intra-Mercurial matter — the strongest evidence that the sun's heat cannot possibly be due entirely or chiefly to meteoric impact. The quantity of down-falling matter necessary to maintain the sun's heat would be equal to about a fortieth part of the earth's mass annually. Now Leverrier's balance will not allow more than four times this amount for the whole quantity of meteoric matter within the orbit of Venus,—granting, that is, to the region of greatest meteoric condensation the widest permissible extension. So that there is only sufficient matter to last for four years, if meteoric down-fall were the sole source of the sun's heat, and the meteors were to be continually used up for that purpose. Four times four years have passed since Leverrier first published his results, and neither has the sun grown cold, nor the supply of meteoric matter perceptibly diminished.

Let us next turn to the results obtained by Leverrier when he put the planet Venus in the delicate balance of analysis. Here we come again upon evidence respecting the sun's distance, the theory of Venus leading, like the theory of the sun, to the conclusion that the sun's distance had been over-estimated by three or four millions of miles. But an interesting confirmation of the accuracy of Leverrier's theory of Venus is the point to which we would chiefly invite the reader's attention. Of course, on the occasion of the late transit, much depended on the accurate calculation of the time when Venus would cross the edge of the sun. The results satisfactorily proved the accuracy of the calculations. For instance, Mr. Hind found that using the old tables of the sun and Venus, the calculated time of egress at Mokattam in Egypt differed by 13·5 minutes from the observed time; whereas when Leverrier's new tables were used the calculated time was only five seconds in error. This is very satisfactory evidence of the value of Leverrier's labours.

We come, finally, to Mars, for the planets Jupiter and Saturn follow exactly the motions which theory ascribes to them.

One of the most interesting points, as it seems to us, in Leverrier's discussion of the motions of Mars is the fact that it indicates the wonderful power of mathematical analysis in dealing with matter, apart from all direct evidence as to the existence of such matter. Suppose no telescopic search had been made for the planet which astronomers of old time supposed to be travelling between the paths of Mars and Jupiter. Leverrier's analysis of the motions of Mars would in that case afford evidence decisive of the question whether a large but as yet undetected planet is really travelling in that region or not. It shows that there can be no such planet, simply because Mars shows no traces of the disturbing influence of any considerable planet. But Mars does show the influence of disturbing matter,

not giving him a strong pull in this direction at one time and in that direction at another, as a single planet would, but exerting a more equally distributed action. This is the influence of the zone of asteroids, and in this action we have a means of weighing that zone.

But here, unfortunately, a difficulty arises. Leverrier long since pointed out that the peculiar form of disturbance thus affecting Mars might be explained either by ascribing to the whole family of asteroids, when taken together, a weight equal to one-eighth of the earth's, or else by adding so much to the estimate of the earth's weight. This last result corresponds almost exactly with the effect of increasing the estimate of the sun's distance to the degree indicated by Leverrier's other researches. Some of our text-books, with their usual happy freedom of manner, combine these two results (stated by Leverrier in 1861), and assign to the asteroids a total mass equal to one-eighth part of the earth's, while also asserting that Leverrier's researches on Mars, like those on Venus, proved that the earth's mass must be increased by an eighth. But we cannot assign the observed effects fully to both causes at once, though we may assign part of the observed effects to one cause and part to the other. Leverrier himself does not, indeed, mention this. His words are as follows: — "Only two hypotheses were possible, as we explained on June 3, 1861; either the hitherto neglected matter resided in the totality of the ring of small planets, or else it must be added to the earth itself. In the second case, and as a consequence, the distance of the sun must be diminished by about a twenty-fourth part of the" (then) "received value — that is, we are led to the result already obtained from the theories of the sun and Venus." But then, if we ascribe the whole effect to the original erroneous estimate of the sun's distance, we are left in this predicament — that we can assign *no mass at all* to the whole family of asteroids.

Here, then, as in the case of Mercury, we see that we have to wait till the sun's distance is determined with much more exactness than heretofore, before we can ascertain the real results of Leverrier's planet-weighing. He has put these planets severally in the balance, and noted the result; but the balance itself has to be inquired into before we know what the result means. It can hardly be doubted that the transit-observations made last December will come in very usefully at this point. We shall learn from them how much must be added to the old estimate of the earth's weight (or, which is exactly the same thing, how much must be taken from the old estimate of the sun's weight), and therefore we shall know how much is left, on the one hand, for intra-Mercurial matter, and, on the other, for the asteroidal family.

Now, it is somewhat strange that this being so — Leverrier's own results pointing to the importance of direct measurement of the sun's distance by transit-observations, or in any other available manner — he has nevertheless spoken quite disdainfully of those direct modes of measurement. Because in weighing the planets in his analytical balance, poised and adjusted with marvellous skill, he has found clear evidence that the old measurements of the sun's distance were erroneous, he deprecates new measurements. "Here I have," he says in effect, "a way of testing such measurements so delicate that in itself it is preferable to them all. The balance I have used is one which will improve with advancing years, and as, in 1861, it had detected the error in measurements of the sun's distance effected in 1769, so, long before the transits of the twenty-first century, it will have given results altogether more accurate than those you are attaining at so much expense by observing the transits of the present century." This is all very well; but Leverrier's own results leave something to be explained which these despised transit-observations are competent to explain at least a good deal more accurately than he has himself explained them. His method, carefully kept in bottle for another half-century, may, and probably will, give us a much clearer wine (to use Bacon's simile), but in the meantime we must be content with the vintage of 1874 and 1882.

But this in no sense affects the value of Leverrier's own labours. Beyond question he has deduced from the observed motions of the planets all that at present can be deduced as to the masses of the different known and unknown parts of that complex system, — containing bodies of all orders of size, density, and structure, — which occupies the domain of space ruled over by the sun. We spoke of his work, begun more than a third of a century ago, as the noblest work in pure astronomy which this age has seen. This certainly seems no exaggerated estimate of its value. A portion only of the work

— that which led to the discovery of Neptune — has been called the greatest achievement of mathematical astronomy since Newton's discovery of the law of gravitation. As regards this portion of his labours, his credit is shared by another astronomer not less skilful than Leverrier, though circumstances have prevented him from pursuing his course along the difficult path for which his powers fit him. Other astronomers, again, have shared with Leverrier the labour of analyzing the movements of particular planets, or rather have gone over the same ground with somewhat similar results. But as Sir John Herschel alone of all astronomers ever surveyed with high telescopic powers the whole of that star-lit sphere surrounding our earthly home, so Leverrier alone has submitted to the searching scrutiny of the higher mathematical analysis the whole of that complicated system to which the earth belongs. It adds not a little to the credit due to him for these achievements that during the greater part of his labours he held a high official post, the duties of which (had he been content to follow an example but too common) might well have exonerated him from the continuance of independent labours so arduous and exacting.

From Temple Bar.

HER DEAREST FOE.

CHAPTER IV.

THE Euston Terminus was all alive, and a goodly army of porters ready to disentangle the passengers' luggage, with small regard to its well-being, one bright but sharp afternoon in early spring, as the 3.30 train from H—— rushed into the station, and the crowded carriages disgorged an eager, pushing, striving mob.

Through its eddies a gentleman who had been waiting about for a few minutes before the train came in, dexterously elbowed his way. Looking sharply into all the first-class carriages, he suddenly paused at one of the second-class, from which a fat female with a huge basket had just emerged, and raised his hat. "Miss Lee," he said; "if I am not much mistaken, Fanny Lee."

"Yes, yes," said a young lady, disentangling herself from a chaos of children, bandboxes, and brown paper parcels; and, putting her hand in his, she stepped out into the light. They stood looking at each other for a moment, as if trying to recall some half-vanished memory. The girl saw a gentlemanlike-looking man, moderately tall, very slight, with dark hair, a spare, expressive face, exceedingly keen dark eyes, and a half-kindly, half-mischievous smile on his clean-shaved lips. He was remarkably well dressed, and wore a sprig of lily of the valley in his button-hole. Indeed, he might have passed for a man of fashion, were it not for the expression of alertness, of bright intelligence that pervaded every line of his countenance and, I had almost said, figure.

She was a little, delicate-looking creature, wrapped in a shapeless waterproof, above which, and shaded by a very indifferent hat, appeared a pretty oval face, with soft brown eyes and a quantity of pale brown hair, not very neatly or fashionably arranged.

The mutual survey scarce lasted a second when it was abruptly terminated by a hasty shove from a heavily-laden porter, which sent the young lady almost into her companion's arms; but, quickly recovering herself, she exclaimed, "Is it possible you are Tom Reed?"

"Quite possible," replied the gentleman drawing her hand through his arm. "Do you doubt it? Come, let us see about your luggage. I suppose you have four or five trunks, three or four packages, a couple of bonnet-boxes, and ——"

"Oh, dear no!" a little sadly though with a smile. "I have but two in the world."

"What a delightful girl to travel with! Have they any special signs?"

"No, no — just my name. There!" — convulsively — "that man is going away with one of them." As she spoke Mr. Reed darted upon him, and rescued No. 1; the other was quickly discovered.

"Now, then! I am afraid that we must take a four-wheeler. Here, cab!" — as though he was monarch of every conveyance that ever paid for a license; so his companion thought, as he quickly but carefully handed her in, saw the luggage placed, and finally jumped in after her.

"And so you are little Fanny," he said, as they got into the comparative quiet of Gower Street, looking straight into her eyes. "I should have known you anywhere. But somehow I fancy you had rosier cheeks at the old parsonage. You are all right, are you? No cold or nervous debility — that's the last dodge, I believe?"

"I am very well," said the young lady; "but not quite so bright as I used to be with poor grandpapa." She sighed and smiled. "And I have had some hard

work in Yorkshire. Hard work never suited me, you know. But, there — I cannot hear what you say, and I can't scream. Shall we stop soon?"

"Presently. Let me put up the window. Have you no shawl or wrap? — it's cold, though so bright."

And they rattled on; occasionally the newly-arrived would utter a word as with a note of interrogation, "Regent Street?"

"No; Oxford Street."

"Opera House?"

"No; Covent Garden."

Twice Mr. Reed called to the driver to hasten, and at last they reached Waterloo.

"Train for Hampton Court?"

"Just gone, sir."

"Next?"

"Not till 5.30."

"By Jove! an hour and a half to wait. Come, Fanny, you look famished. There's soup or something to be had, and a glass of sherry."

"Thank you, I will take a bun or a biscuit. I have not had anything since seven o'clock this morning."

"No wonder I miss the roses; roses don't flourish under such an ethereal *régime*." And the weary traveller was soon summoned to the refreshment-room, where soup, sherry, a table in a quiet nook, a devoted waiter, seemed ready as by magic — the magic of Tom Reed's good-humoured authority and contagious activity.

His young *protégée*, glancing at the very perfect minutiæ of his costume, drew off her own dingy and not neatly-mended gloves with a laugh and a blush which became her greatly. "Well, Tom," she said, "you might have known me, but I am sure I should never have known you in such nice clothes."

"Clothes!" echoed Tom Reed, stretching out one arm, and regarding it with an expression of uneasiness. "Do you call these clothes?"

"What are they, then?"

"Dress," he replied, with much solemnity. "The porters here, and your friends in Yorkshire, probably clothe themselves. I dress." He waited till the pleasant laugh with which she heard him was past, and asked gravely, "And what incongruity do you observe between my garments and myself?"

"Oh, you look all right now," she returned; "but when we met last, you know, you had not an unbroken garment, as you call it, in the world. Though I was such a little thing, I remember poor Mrs. Green, the housekeeper, forever lamenting that Master Tom never *was* fit to be seen. What a mischievous boy you were!"

"Do you remember all that! Why, it must be ten years ago. Well, little cousin," a very kindly, soft expression stealing over his face, "nothing has pleased me half so much for many a day as this plan of Mrs. Travers to have you with her. You will be quite comfortable."

"Do you think so?" a little anxiously, while she held a spoonful of soup midway to its destination. "It is so long since I saw her, and people change."

"She does not," emphatically. "She is a thorough-going brick — a splendid creature altogether."

"I was very fond of her as a child; but then she was always so much with her mother and grandpapa that we were never quite play-fellows; and she is four or five years older than I am."

"Did you know the late lamented Travers?" asked Tom.

"I remember often seeing him, but I do not think I ever spoke to him. He was frightfully rich, wasn't he?"

"Delightfully, you mean. Yes, and I believe your old friend has it all now. Well, I suspect she earned it. He was a fine fellow, the type of the 'grand old English merchant,' but I fancy a trifle jealous and exacting; all Kate's old friends politely warned off the premises. I met her very unexpectedly, about two years ago, at a gorgeous banquet in Westbourne Terrace; she was delighted to have a talk over the old place and people, so I went to call, was presented to the proprietor, and asked to another gorgeous banquet, where I nearly died of starvation."

Fanny opened her pretty brown eyes in amazement.

"Moral and mental starvation, I mean. After that I saw no more of our friend. Next I saw the death of old Travers in the *Times*, and a fortnight or so after, I had a note from her, asking me to call; when I did, I found she wanted to know where you were, and how you were placed. I was ashamed, my dear girl, to be able to tell so little; but I had a clue, and so she found you out."

"And then I had to give a month's notice; and even after that, could scarce get away."

"All's well that ends well," said Reed rising. "I am sure you will be as happy as — as a pet fairy! so make yourself comfortable. I imagine I might get the tickets now."

The young lady sat very quietly in deep, and, from her expression, not unpleasant thought — enjoying, as she well might, emancipation from a comfortless school-room, a troop of noisy, ill-mannered, and not particularly good-natured children, whose exacting mamma looked upon her as a bondmaid, for whom there existed no chance of manumission.

She had drawn on her shabby gloves again, and had just begun to expect cousin Tom back, when he returned, and, taking his arm, they sallied forth to seek their train. As they passed the second-class refreshment room, a very seedy-looking individual issued from it; a short, thin, red-faced man with a dingy, battered white hat, a cutaway coat with baggy pockets, and palpably burst-out boots. Yet he had a hand thrust into one of the pockets and a short stick protruding therefrom, and wore his miserable hat with an indescribable slant, as though the "tone of the turf would hang round him still." This unattractive figure placed himself exactly in their way.

"Tom Reed!" he exclaimed in a hoarse unsteady voice. "Mr. Reed — I don't think I am mistaken."

Tom Reed looked at him, as if puzzled for a moment, and then said, "Why, it can't be Trapes?"

"The same, sir! All that's left of him. And how are you, Reed? World's been going pretty square with you?" continued his curious acquaintance, staring boldly at Fanny, and seemingly resolved on a talk.

"Oh, pretty well, thank you," returned Tom civilly; "but we are barely in time for our train."

"Good five minutes to spare, if you are for Hampton Court. I say, old fellow, I want a talk with you. I have lost sight of you this age past. Where can I find you?"

"Oh, the old place — M. T. office."

"Still there! Well, I don't care to call," screwing up his left eye, knowingly. "I'll drop you a line."

"All right — good morning," cried Tom, hurrying his companion on, and into a first-class carriage.

"What a dreadful man! How could you know him?"

"Poor, unfortunate devil!" returned Tom thoughtfully. "A few years ago he was a sort of fine gentleman I half envied."

"Did he lose his money, poor man?" asked Fanny compassionately. "Still he need not look quite so dreadful."

"No, certainly not;" and then Tom Reed turned the conversation and devoted himself to cheering up the pretty little cousin under his care.

But Fanny was nervous, and could not conceal it. Her sweet, slight nature had been too much tried by the sudden change from her grandfather's loving indulgence to the rugged discipline of her Yorkshire penitentiary. She was too unhinged to look forward brightly, now that hope had come — as fatigue sometimes banishes sleep.

Tom Reed felt her slight arm tremble, as he drew it through his own, to conduct her the short distance that intervened between the station and the Travers mansion.

It was a clear frosty evening, a young moon showing coldly bright in the deep blue sky.

"What a pretty place!" said Fanny looking round her timidly. "Will Kate — I mean Mrs. Travers — always live here?"

"It is hard to say; but I fancy not," returned Mr. Reed. "There, you see those tall wrought-iron gates? — that is our destination."

A few moments more, and Fanny found herself upon the threshold in a flood of light, and in the tender embrace of her old friend, who seemed to her at once strange and familiar. The sudden warmth and glow of kindness was nearly too much for poor Fanny, whose bright eyes, half sad, half mischievous, were dimmed, while her lip quivered.

"Dear child, you are quite tired out; come with me to your room," cried Mrs. Travers, observing her emotion. "Mr. Reed, you will find the *Times* and magazines in the drawing-room — if I may offer any literary attraction to one of the initiated? *So* much obliged to you for bringing me this dear little waif. Come, Fanny;" and the rescued bondmaid was swept up-stairs to a charming room, next Mrs. Travers's, where a ruddy fire, fresh chintz hangings, a dressing-table all pink and white muslin, a dainty little white bed, looked welcome most pleasantly and impressively. "How cold and pale you look!" said Mrs. Travers, assisting to take off her cloak. ("And how shabby," she *thought*.) "Still, it is the same little Fanny, and will bloom out soon again with the roses of former years under my care, I hope." Here the respectable Mrs. Mills entered with a can of hot water. "Do you not remember Mills, Fanny?"

"Of course I do! And, Mills, do you not remember me?" cried Fanny, seizing her hand and kissing her withered cheek;

a piece of spontaneous kindliness that bound Mills to her from that moment.

"Dear, dear! to think that this is little Miss Fanny!—grown quite a woman, I do declare."

"Yes, it is astonishing; yet we could not expect her to stand still," remarked Mrs. Travers. "Now, dinner will be ready in a few minutes, and I daresay Mr. Reed is quite ready for it. When he leaves, we shall have plenty of time to talk together; and how much we have to tell each other!"

"Indeed, we have; but, dear Kate—I mean Mrs. Travers—you are quite different from what I remember you—older looking and better looking; and yet the same."

"It is well you have qualified 'older looking,' little one, with 'better looking,' or I should prepare to be awful! I will leave you to dress, or not, as you like; and when you join us in the drawing-room, dinner will be ready——"

"How did you recognize each other?" asked Mrs. Travers, as she dispensed the filleted soles.

"Well, we jumped at each other," returned Reed, setting down his glass of sherry with an air of discriminating satisfaction. "As I glanced into the chaos of bundles, bandboxes, and babies in which she was engulfed, a vision of a silvery trout-stream, a sensation of terror and wet feet, much exultation, a trifle of conscience and a large proportion of gratitude, associated a slight young lady in a waterproof with a certain great deliverance wrought by her opportune warning in days of yore, and memory whispered, 'That's she!'"

"Yes, yes, I remember it," cried Fanny, who had already revived marvellously under the benign influences around her; "and I think grandpapa was equally relieved. He had solemnly declared he would flog you if he caught you poaching; and I knew quite well he did not want to catch you, so I slipped away out by the Beech Wood, and gave you notice. It was quite as much for his sake as yours." A pretty little defiant nod closed her speech.

"Did Fanny know you?" asked Mrs. Travers.

"That is a doubtful point. According to her, the general excellence of my attire militated against my identity."

"Well, Mr. Reed, I must say that my recollection of you in days of old does not hold you up as the glass of fashion or the mould of form."

"No indeed; you were a dreadful pickle; yet how fond poor dear grandpapa was of you," added Fanny.

"He was far kinder than I deserved," returned Tom Reed, with momentary gravity; and dinner proceeded without anything further than newspaper talk till dessert banished their attendant.

"I cannot tell you what pleasure it gives me to see you both," said Mrs. Travers, permitting Tom Reed to fill her bubble-like glass with claret. "Besides the pleasure of meeting old, and I think congenial friends, the relief from the sense of isolation that has oppressed me since—since my widowhood, is wonderfully delightful. I have never been very fond of Christmas since I grew up, but this one I spent quite alone. The people on either side here were very good in calling and leaving 'Kind inquiries;' but of course they are total strangers to me. So all I could do was to give the servants a good dinner, and let them invite their friends. They sent me up a piece of their pudding at my luncheon, and, by avoiding a late dinner, I managed to forget it was Christmas day. I hope I shall not spend another like it."

"No, no, we must change all that," said Reed cheerfully. "And may I ask how are all your affairs progressing? When I saw you last week, you were experiencing some difficulty with Wall and Wreford. They objected to your rather munificent suggestion of sharing your fortune with Sir Hugh Galbraith."

"Yes; Mr. Wall would not hear of it, which rather surprised me. I fancied he was annoyed at Mr. Travers leaving all his money away from Sir Hugh. Now I observe he is not so great a favourite. Still, Hugh had evidently been taught to look upon himself as poor Mr. Travers's heir, and I think he has been badly treated; nor have I a doubt that the missing will would have given him a share of the property, could we but find it."

"Still, to go halves with him voluntarily," said Reed smiling, "was slightly quixotic, if you will not quarrel with me for saying so."

"I do not think it was," returned the young widow thoughtfully. "Fifteen hundred or two thousand a year, all my own, are great riches to me; but by no means such wealth to Sir Hugh, with a position to keep up, and I suppose the usual costly tastes and habits of his class. In fact, but for the fear of being thought idiotic, and outrunning Mr. Travers's real wishes, I would willingly have given Sir Hugh the lion's share."

"And what decision have you arrived at?"

"Oh, Mr. Wall would hear of nothing beyond a third of the whole being offered; and you must remember we do not yet know what the whole will be. Mr. Wall rather startled me by saying that too much munificence might suggest that the real will was more favourable to Sir Hugh than I liked, and therefore not lost, but suppressed! Do you think the general colour of men's minds of so vile a tint, as to distort so basely a simple wish to do right?"

"What a horrible idea!" cried Fanny, who was listening with deep attention.

"I have by no means a bad opinion of my fellow-creatures. Still, they are inclined to attribute very base motives for acts they cannot understand or account for," replied Tom Reed. "I heartily wish the second will could be found; but I suspect something or other occurred to renew Mr. Travers's displeasure with his cousin, and, thinking it too favourable, he destroyed it."

"No, Tom, no!" cried Mrs. Travers, with animation. "You must forgive me," she said, interrupting herself and smiling; "but when eager or in earnest the old name comes so readily to my lips."

"I shall *not* forgive you, my dear Mrs. Travers, if you go back to the newer and colder appellation. Pray let me be Tom, who is quite as anxious and proud to be your servant and ally now as in our old poaching days." There was a tinge of earnestness under this pleasant, airy manner, very acceptable to the fair but lonely widow.

"So be it," she said laughing. "I accept you as Tom, and my champion to boot. But to return. I do not think Mr. Travers ever destroyed his will. I should more readily believe he had not made a second, but that it seems so positively proved he did. I confess I have felt at times a strange uneasiness about it, but have now made up my mind that, even if found, it will make no material difference — Sir Hugh will probably have a handsome legacy, but the bulk of the fortune and all authority Mr. Travers has no doubt left to me."

"That is highly probable," observed Tom Reed. "Where is this Galbraith?"

"Somewhere in India. He was, I believe, on the point of coming to England when the Munity broke out. Indeed, he was at Calcutta on his way, but he immediately returned to join the remnant of his regiment, the —th Light Dragoons, which was nearly cut to pieces at the beginning of the outbreak. I have seen his name mentioned once or twice as a very gallant officer; but I fancy he is a thorough aristocrat — brave enough, but proud and overbearing, and unjust. His letter to Mr. Travers on our marriage was almost unpardonable. Oh, the contempt with which he spoke of me!"

"And why, I should like to know!" exclaimed Fanny indignantly. "I am sure you are as good as he is?"

"That depends on the exact meaning attached to goodness," said Mrs. Travers smiling. "I can afford to forgive him, because he did not know what he was writing about. Indeed, I imagine these high-caste men *know* nothing thoroughly."

"Why, Mrs. Travers, you are quite democratic!" said Tom Reed.

"Dear me!" cried Fanny with some awe, "I suppose Sir Hugh Galbraith is of a very old family indeed."

"So old as to be lost in the mists of antiquity. His ancestors did heaps of mischief on the border in bygone days, and no particular good, I daresay. Notwithstanding the difference in their ages, Sir Hugh and poor Mr. Travers were cousins. I think my husband acted as a sort of guardian to Sir Hugh. Yes, Fanny, he is a very great man indeed — a tiny acorn on the topmost twig of the family tree. Still, I should not like him to suffer from his cousin's partiality for me. Generosity may be an aristocratic virtue; I am content with more homely justice, and will try to practise it."

"And the upshot of all this is ——" put in Tom interrogatively.

"That Messrs. Wall and Wreford have written by my direction to inform Sir Hugh how matters stand; that it is my intention, as soon as they can be arranged, to make over to him a third of the fortune bequeathed to me. I cannot help imagining he will refuse to accept, estimating me as he does; but Mr. Wall says he is a poor man, every acre of the few left mortgaged up to the gate of the family fortalice, for it can hardly be called castle."

"He has made a great ass of himself," said Reed, "and is in luck to find such a residuary legatee as yourself; you certainly give the best refutation to his insolence by your generous conduct."

After some more conversation about the happy old days at Cullingford, Tom Reed, observing his cousin's pale cheek and drooping eyes, bid the ladies "Good evening."

"Do you know I like that cousin of

yours so much, Fanny," cried Mrs. Travers as the door shut upon her departing guest. "There is an undercurrent of good feeling with all his lightness and careless ease."

"I was so surprised to see him quite a fine gentleman."

"A fine gentleman! My dear Fanny, you must not use opprobrious terms in speaking of your cousin. I believe he is a good fellow, which is a different affair altogether. And now, dear child, you look quite worn out. You must go to bed. Tell me, do you feel as if you would be happy and at home with me? I want you to feel so. I am grieved to think I was obliged to lose sight of you for a while. Did you think I had forgotten you, Fanny?"

Fanny's frank bright eyes filled up suddenly. "Yes, Kate, I did; and oh! I cannot tell you how desolate and miserable I was. I felt that if you could forget me, there was no help anywhere."

Mrs. Travers was silent for an instant; then, throwing her arms round her young friend, exclaimed, "There! let us not talk about it any more. You know now I did not, that I could not help it; and for the future you may trust me."

"I am sure I can!" cried Fanny, returning her embrace with much warmth. "And oh, Kate! what a lovely house you have; and what beautiful flowers and things! Are they all really yours? I feel half-frightened to hear you order about that polite gentleman who waited on us at dinner."

"Ah! the change in my exterior life is as nothing to the change within. But come, dear, to bed — to bed — to bed!"

CHAPTER V.

THE two months which succeeded Fanny Lee's arrival at her friend's house were certainly the happiest either lady had known for a long time.

To Mrs. Travers the sense of freedom, at first suppressed partly by her tender and respectful regret for her deceased husband, and still more by her shrinking from her own natural feelings as unseemly, gained more strength each day.

While to Fanny the glorious consciousness of having nothing to do but disport herself in the sunshine fortune had suddenly shed upon her, was enough delight for the present.

She played and sang prettily, and worked all sorts of fancy-work neatly and tastefully; but it was wonderful to watch the varied changes she performed in the course of the day — from the piano to her work-table, from the work-table to the garden (weather permitting), from the garden to a sudden and complete re-arrangement of her own room or Mrs. Travers's, or an enthusiastic compilation of a cap for Mills. It quite fidgeted her to see Mrs. Travers reading steadily for a couple of hours with rapt attention, answering her many questions with unswerving good temper, though often at random. At first, the graver of the two friends tried to preach fixity of purpose, but in vain, and so wisely and quietly gave up the attempt; finding that, although the effort to inculcate first principles was hopeless, whatever she gave Fanny to do as a task for *her*, was most faithfully performed.

Then, when a rare bright day came, how delightful it was to order the carriage and enjoy a drive in the beautiful country which surrounds Hampton Court! Tom Reed was a great addition to the pleasure of their life. He was a frequent visitor, and was always considered due on Sundays, when he generally arrived armed with *Punch* and the latest numbers of the best periodicals. Then Mrs. Travers enjoyed hearing the latest political rumours, and a little discussion of the various new opinions perpetually cropping up. Tom Reed, as he was universally called, was a very agreeable companion — bright, keen, accustomed to focus his thoughts, which, if not profound, were shrewd, and sharpened by constant friction with other minds as bright and often deeper than his own; accustomed by his position on the staff of a high-class morning paper to observe the conflicting currents radiating from the old centres of belief. For Fanny he generally brought curious and valuable morsels of fashionable intelligence, perhaps not so carefully authenticated as they ought to have been, but not the less acceptable on that account. To Reed this easy admittance into the society of two refined and accomplished women, the delightful, graceful homeliness — if such a combination of terms may be used — of the old-fashioned house at Hampton Court, was wonderfully delightful and wholesome. For Tom had had his evil times and trials, and had run the not uncommon round of spending all his money in finding out how to make more.

To Fanny he seemed a fearfully clever, brilliant, sceptical, scornful man of fashion, whose wicked theories she constantly set herself to contradict and subvert. Many were the stinging little darts she contrived to launch against the pachy-

dermatous Tom, so that a sparring match between the cousins was generally one of the evening's amusements.

The next-door neighbours, too, were sympathetic. The woes of a rich widow were naturally attractive to an impecunious honourable, whose husband, though not defunct, was "nowhere" in the world of fashion and respectability. Many were the invitations pressed upon the friends by the Hon. Mrs. Danby and her daughters; but though Fanny Lee often availed herself of these opportunities to cultivate the great world, Mrs. Travers, rigidly intent on showing respect to her husband's memory, invariably refused. An amiable readiness to lend her carriage to the honourable mother and her graceful brood amply compensated for the lack of personal intercourse. Various were the scraps of intelligence collected by Fanny during her visits; sometimes it was a titbit of Palace gossip, for Mrs. Danby's ostensible attraction to Hampton Court was a "relative" located in that refuge of impoverished aristocracy. Oftener it was some scandal touching the High Church curate, and oftenest military reports.

"Do you know, Kate," she burst out one day after a drive to Kingston with Mrs. Danby and one of her daughters, "that the officer who is coming here instead of Major Cunliffe is a Captain or Colonel Upton; he is a brother officer of Sir Hugh Galbraith, and Mrs. Danby used to know Sir Hugh long ago, and says he was the most tiresome, overbearing man that ever lived, so ——"

"I trust and hope, Fanny, that you did not speak unadvisedly with your lips, or launch out into abuse of my enemy!" cried Mrs. Travers interrupting her. "I am most anxious that no syllable of depreciation should be traced to me or mine."

"I am sure I did not; or at any rate if I said anything, it was not much," returned Fanny colouring guiltily.

"I am quite sure you did," said Mrs. Travers smiling, though annoyed. "Confess, now, that no devil was ever painted blacker than you depicted poor Sir Hugh."

"No, no, indeed!" exclaimed Fanny earnestly. "I think I did say that, from all I could learn, Sir Hugh Galbraith was an unforgiving, vindictive, insolent, greedy, disagreeable man."

"And that is not much," said Mrs. Travers resignedly. "Well, in future, my dear girl, will you kindly keep silence even from *bad* words if Sir Hugh's name is mentioned?"

"I will indeed, Kate, if you wish it. But I can tell you Mrs. Danby said three —oh! five times as much as I did, and" —lowering her voice—"she said, too, that Sir Hugh was on the point of running away with Lady Somebody, or the Countess of Something, a married woman, when her father, who was a rich solicitor, found it all out, and had him arrested for debt, and so he couldn't—that is Sir Hugh; but he was so violent that it took three or four of those dreadful people—bailiffs, I think—to capture him."

"Really, that was taking a very shabby advantage of poor Sir Hugh," said Mrs. Travers laughing. "But I do not believe that long story, Fanny; depend upon it, there is but a slender foundation for such a legend."

"Well, Mrs. Danby assured me it was true; she heard it from Lord—oh, I do not know who!—who was in the same club with Sir Hugh Galbraith, and ——"

"It is really no great matter, Fanny; just promise me, like a good girl, never to talk of him again."

"Very well, Kate; but I must tell you that when Mrs. Danby heard poor dear Mr. Travers was a cousin of Sir Hugh's, she seemed to know all about him at once. She said, 'Dear me, I had no idea it was *that* Mr. Travers;' and went on about his high family, and his riches, and how much she felt for you, and what a distinguished-looking woman you were, and what a pity it was for you to be lost to society, but that time would soon pass, and you could come out a little more. You cannot think what a nice feeling sort of way she spoke; and oh, Kate, she wants to know if you would kindly let her have the carriage to-morrow; she wants to go over to Kew to call on Lady de Courcy."

"I am very sorry, but she cannot have it," said Mrs. Travers, dryly. "I want to drive into town myself to-morrow. The Indian mail is in, and it is just possible Wall and Wreford may have a reply from Sir Hugh Galbraith. I do hope he will accept my offer, though I should not be surprised if he rejects it with scorn."

"What a stupid, strange man he must be!" observed Fanny.

Mrs. Travers, somewhat to her surprise, found her conjecture right. Messrs. Wall and Wreford had received a reply to the epistle they had written little more than two months before. They evinced such a decided disinclination to let her see it, that she insisted on perusing it herself. Feeling distrustful of her own

self-control, she quietly pocketed it and departed, telling Mr. Wall that she would see him after she had digested the contents.

On reaching home, Mrs. Travers felt much cheered on finding Tom Reed assisting Fanny in some energetic amateur gardening, which was her last and most lasting whim.

"You will stay to dinner, of course?" she said. "I want a committee of the whole house to discuss Sir Hugh Galbraith's letter. Mr. Wall has told me so much, that he rejected my offer, and, knowing this, I shall take time, and fortify myself with dinner before I read it. I am sure it is odiously insulting."

"Do you know that Mr. Ford is in the drawing-room?" said Fanny, with the slightest possible grimace.

"No, indeed. What does he want? I suppose only to pay a visit. Well, I cannot ask him to stay to dinner to-day, but I will for Sunday. I could not read out Sir Hugh's letter before him. Why, I cannot tell, for he has always been most friendly and obliging to me. So, Fanny, I will go in and see him."

Mr. Ford was deep in the *Times* when Mrs. Travers entered and greeted him kindly, yet with a nameless something of caution in her usual frank cordiality, which he did not fail to notice and interpret to the satisfaction of his immense, yet uneasy vanity.

"I trust, my dear Mrs. Travers, you will not consider me intrusive," he began.

"Certainly not, Mr. Ford. I am very glad to see you; but are you quite well? you have been suffering from cold? which is perhaps the reason you have kept so long away."

"You are very good to notice my absence when you have the society of so new and agreeable a friend as Mr. Reed." The head a little bent to one side with a jerk, "I could scarcely hope ——"

"Oh, Mr. Reed is a very old friend as well as a very pleasant one," interrupted Mrs. Travers, carelessly, and by no means in an apologetic tone. "He is a relation, you know, of dear old Mr. Lee, and was quite a playfellow of Fanny's and mine."

"Well," resumed Ford, "I have ventured to call, as I see the Indian mail is in, to ask if there is any communication from Sir Hugh Galbraith?"

"There is, indeed," replied Mrs. Travers, sitting down with a sigh; "and a very decided rejection of my offer. I am quite vexed; perhaps when he thinks better of it he may change his mind."

"Hum! He is a great fool, that is, unless he has formed any idea that a will more favourable to himself may turn up; and, even if it does, he would probably be better off with your offer."

"I have no doubt he would," replied Mrs. Travers, slowly untying her bonnet. "I feel quite sure my husband would not have left him as much as I wish to give."

"Suppose my late respected employer was subject to crotchets like other men?" answered Ford, rubbing his hands slowly together, and putting his head slightly to one side, interrogatively. "What a cruel triumph it would be to Sir Hugh if the bulk of the property had been left to him and a mere legacy to you?"

"Why imagine anything so improbable?" replied Mrs. Travers calmly, yet with a perceptible tinge of contempt in her tone. "Mr. Travers would never have been unjust to me."

"No, no, of course not; but, after all, he must have been fallible like other men — very fallible, I should say, or he never would have used such words as —— But I beg your pardon, you forbid me to allude to that unhappy occurrence."

"I did," said Mrs. Travers shortly; "so you ought to avoid everything that can possibly lead up to it," she added good-humouredly. "And tell me now how is poor old Gregory's family getting on; you mentioned that he left a son and daughter not very well off?"

"His son is well-to-do in his way; he commands one of Duncan's ships; he sailed for China some time after his father's death: but the daughter is in bad health; she is a widow with several children, and very badly off. The brother does what he can for her, but he has a wife and children himself."

"Then, my dear Mr. Ford," cried Mrs. Travers earnestly, "do pray see how she is, and provide what is necessary for her and the poor children. I would go and see her most willingly, but a total stranger — the widow of a man who must be to her in some degree a personage, having been her husband's employer — might be troublesome and oppressive. Pray assure her of my sympathy and readiness to help her. I know Mr. Travers would have done so. He valued poor Mr. Gregory very much, and I feel quite sure he would approve what I propose."

"Certainly," said Mr. Ford in a suppressed and rather choked tone. "Certainly," he repeated, clearing his throat; "Gregory was a very faithful servant — and — and — your amiable, generous read-

iness to relieve misfortune touches me to the heart."

"I imagine the power to relieve suffering, even in a slight degree, is too great a luxury not to require self-control as much as any other enjoyment," returned Mrs. Travers carelessly, while she thought, "How like an old-fashioned novel he talks!"

"It is only one more token of that excellence long ago recognized by me," resumed Mr. Ford, throwing out his hand, which held a yellow silk pocket-handkerchief, as though about to throw down his gage to all comers in defence of the young widow's amiability and generosity.

"Well, well!" she exclaimed good-humouredly, "I cannot allege the favourite excuse for keeping one's money in one's purse, for I have very few claims upon me. But, Mr. Ford, when sufficient time has elapsed to assure my authority under Mr. Travers's will, you, too" — she hesitated, blushed, and showed a charming gracious confusion — "you, too, shall find that I am not ungrateful for the friendship you have always shown us both."

"My dear madam — my dear Mrs. Travers, you are very good; but you must be aware that there are free-will services, which to pay ——"

"Would be the cruelest insult," interrupted Mrs. Travers. "Certainly I should indeed be 'of the earth, earthy' if I knew it not. But, Mr. Ford, I am not without my ambitions. If the house of Travers really passes into my hands, I should like to keep it up, to increase its prestige, to renew its youth; to prove to the world — my husband's world — that I am no unworthy inheritor of his name and fortune." She rose as she spoke, and began almost unconsciously to move to and fro. "And in the pursuit of such an object might I not also do you justice, as well as prove my respect for you — my confidence in you, and improve your position? Not, I confess, that I should, unless I change considerably, like partners — even a junior partner. I should like to rule alone, but I might improve your position materially."

She paused. Mr. Ford listened eagerly as she spoke, and passed his handkerchief rapidly over his face.

"You are quite a mercantile Portia," he said, in a thick, husky tone, that cleared as he proceeded. "It is remarkable to observe the natural enthusiasm of youth directing itself into such a channel."

"Ah! you despise my youth," she cried, pausing, and leaning against the back of a chair, while a delicate colour stole over her cheek, for it takes long experience to steel the soul against a sneer. "But, you must remember, I am older than my years; that I have studied to be old, and almost succeeded."

"Your ambition is, I am sure, worthy of all respect," returned Ford; but he dragged out his words with a visible effort. A short silence ensued, and Ford resumed: "Then Sir Hugh Galbraith shows himself quite inimical to your just rights, as they at present appear?"

"Yes — quite — nay, he threatens to contest the will; indeed, Mr. Wall seems to think he has some idea that another exists. I have not yet seen the letter. Suppose," continued Mrs. Travers with the odd sort of restless desire to get rid of him which generally came over her — "suppose you come and dine here on Sunday, and we will talk it all over. I am sure you will be interested; and more, if necessary, you will help me to fight this man."

She smiled very sweetly upon Ford as she spoke. He made a slight sudden movement towards her, which he dexterously turned into typical hand-washing, and began to speak with eagerness.

"You know well" — then checking himself, he recommenced — "You may, indeed, count on me; and, insignificant as I seem, I may possess more power than you think. Be that as it may, I believe you know the deep interest, the — the — friendship, if you will accept the expression, that I entertain for you; and whatever course you may decide upon, I shall be at your service, with or without reward. *That* is a matter on which I do not dare allow my thoughts to dwell."

"No, no! I am sure you do not," returned Mrs. Travers with complimentary readiness, quite heedless of his dramatic emphasis, her mind preoccupied by the letter she longed, yet half feared, to read. "You are much above any personal considerations; but you shall not find me ungrateful, I assure you so," holding out her hand. "Do not forget Sunday. We dine at five on Sundays."

Ford's countenance darkened, and his smile, as he accepted his dismissal, was very snaky.

"And, oh, Mr. Ford, be sure you see poor Mrs. Bell, old Gregory's daughter. I wish you would send me her address."

"I will do so," he replied; and, bowing stiffly, departed.

"There is something the matter with that man," thought the young widow, as she walked towards her dressing-room.

"He is changed in some way; but he is a very good fellow. He must be — he always has been — and why should he change! I wonder why I am always so glad when he is gone!"

Dinner passed less agreeably than usual, for the three friends were oppressed by the anticipated unpleasantness of Sir Hugh's letter. Tom Reed did considerably the largest share of the talking. At last the more solid portion of the repast was cleared away; the grave and discreet Edwards gave the final touch to the dessert dishes, which perfected their mathematical precision, and departed.

"Now or never, Mrs. Travers — courage! Take a glass of sherry, and open the fatal scroll."

"Oh, I am quite equal to the occasion without such extraneous aid," returned Mrs. Travers smiling, as she drew forth the letter and opened it slowly. "What a horrible hand! but cruelly firm. It has evidently been dashed off in hot haste. I must glance through it before I read aloud." (Reed and Fanny naturally looked at their hostess as her eyes eagerly scanned the page. First, the quick colour flushed up to her brow, then faded away as rapidly, and left her almost pale. When she came to the end she laid it down for an instant with a slight, bitter smile.) "Listen to this!" she exclaimed, taking it up again, and proceeded to read in a clear, quiet voice: —

"Gentlemen, — I am in receipt of yours of ——, announcing the death of my cousin Mr. Richard Travers, and the liberal intentions of his widow towards me. Be so good as to inform your client that I am not disposed, by accepting obligations from her, to imply approbation of the deplorable weakness which disgraced the close of my unfortunate relative's life. I think it right to add a report that another and a very different will is in existence has reached me. I am on the point of starting for England, to ascertain, as far as possible, the truth, and, in any case, to try if the law can uphold a will so infamously unjust, and made evidently under the undue influence of a lady whose antecedents could not have exactly fitted her to be Mr. Travers's adviser. I, therefore, prefer claiming my possible rights to sharing the spoil with her, and beg that I may receive no further propositions on the subject.

"I have the honour to be, gentlemen, etc., etc., HUGH GALBRAITH."

When Mrs. Travers ceased reading, she looked up at her listeners and kept silence.

"What a bitter bad temper the man must have been in when he wrote that!" cried Tom Reed.

"I am sure he is a detestable, ungrateful thing!" added Fanny.

"You see Wall was not so far wrong when he said that too liberal an offer might suggest an idea of being bought off," continued Reed.

"To a man of Sir Hugh's calibre, perhaps," said Mrs. Travers slowly, with her eyes still fixed on the letter. "See," she went on, handing it over to Reed, "he had written 'woman' before 'lady,' and put his pen through it, not liking, I suppose, to be conventionally rude."

"Yes, yes, I see," he replied, as he glanced over Sir Hugh's effusion. "A most unwarrantable letter — ungentlemanlike, even. You really deserve some credit for taking it so calmly."

"Do I?" returned Mrs. Travers. "Do I take it calmly? If it ever happens that I can pay my debt to Sir Hugh, he will not fare the better for my calmness! What have I ever done to deserve such treatment? That he should be hurt and disappointed by my husband's will I am not surprised; but does he think Mr. Travers had not a right to marry any one he liked? And why should I be so distasteful to Sir Hugh Galbraith? Surely he does not fancy that we are still in the feudal ages, when humble birth was more disgraceful than misconduct? Why should he disdain me without knowing me? Pooh! Why do *I* trouble myself with such conjectures? What is he and his contempt to me? I can well afford to despise both."

She had spoken with repressed vehemence, and stopped abruptly. Reed looked up earnestly, as if struck by her tone, and Fanny exclaimed: —

"And I daresay you are just as well born! I always heard your father ——"

"Nonsense, Fanny," interrupted Mrs. Travers. "I only know and acknowledge my mother's relations, who are of the people. The only help we ever had was from cousin Hicks, and poor cousin Hicks was not a model of good breeding; but I do not think he would have attributed such an offer as mine to a desire to preserve the lion's share of the spoil."

"He certainly never would be such an idiot as to refuse a good offer and run his head against the *chevaux-de-frise* of the law, as Sir Hugh threatens; but it is a mere threat! When he arrives in Eng-

land he will find out how absurd any attempt to shake your position would be."

"I suppose he will, Tom," returned Mrs. Travers. "Still, this man will give me trouble and pain. He has been wronged, and I cannot make it right. Try and throw it back as I will, his scorn hurts me; the material superiority of my position hurts me. You may laugh, Tom; but I should like to give him his choice of weapons and beat him in a fair fight. My money is my weak point."

"Long may you continue to suffer from such weakness!" exclaimed Reed fervently. "You really are the most chivalrous lady I have ever had the pleasure of meeting."

"Oh, I daresay you think me very silly — but I am what I am. He says he is coming to England. I feel that his arrival will be the beginning of troubles."

"I am sure I wish some one would give him a bear's hug and finish him," cried Fanny, indignantly. "Never mind, Kate! He cannot take away everything from you, as he would like, I daresay. So you must try and forget him and be happy. Do not let him vex you."

"I shall try and follow your advice, dear," returned Mrs. Travers smiling, and resuming her usual tone, as the indignant colour which had mounted to her cheek faded away. "Come, let us go into the drawing-room; and, to turn our thoughts, suppose we plan out that little tour I have projected for the summer?"

Accordingly the three friends adjourned into the pleasant, perfumed drawing-room, where "Bradshaw" and "Murray" helped them to much lively talk and delightful plans. Mrs. Travers was unusually bright, and Sir Hugh seemed forgotten.

But long after Tom Reed had bid goodnight, and Fanny Lee's bright eyes were closed in sleep, Mrs. Travers sat thinking, with her elbows on her dressing-table, and her chin resting on her hands, till her candle was burnt down in the socket; and then she started up, extinguished it, and, opening the shutter, brushed out her long, chestnut-brown hair in the cold moonlight.

From Macmillan's Magazine.

RICHARD BAXTER.*

IT may be in the recollection of some that in the course of last year I assisted at a like celebration to this in the town of Bedford. It is difficult to conceive a greater outward contrast than that between John Bunyan and Richard Baxter; between the stout burly youth who played on the green at Elstow, and the pale, lean, dyspeptic student who came hither from the banks of the Severn; between the homely, direct language, the native poetic genius of the illiterate tinker, and the multifarious knowledge, the hair-splitting arguments, and the prosaic disputations of the chief of English Protestant schoolmen. Their lives ran almost parallel to each other, yet, so far as we know, the one passed his threescore, the other his threescore and sixteen years without ever having seen the other, without having ever grasped each other's hand or looked in each other's face. We are far better acquainted with both than either at the time could have been with either. But there seemed to be special reasons why, though with some hesitation, I should respond to the invitation with which I was honoured on this occasion, and endeavour to bring out some lessons peculiar to Baxter, and full of instruction for our age, perhaps even more than for his own.

I. Unlike Bunyan, he lived not in the byways and corners of religious biography, but in the very thick of the crowded and eventful conflict of the national crisis — known, feared, hated, beloved throughout the realm. He was one of those who, without occupying the first place amongst men of letters, or the first place amongst men of action, occupy a conspicuous place in both. There is a saying of Luther's in which he divides the foremost men of his time and country into four classes: — *Words, not deeds* — Erasmus, the great scholar; *Deeds, not words* — Martin Luther himself, the great reformer; *Deeds and Words* — Philip Melanchthon, scholar and reformer; *Neither deeds nor words* — Carlostadt, the useless iconoclast. This is a classification which runs through all ages, and not least through the seventeenth century of our own history. At

* An Address at the Inauguration of the Statue of Richard Baxter, at Kidderminster, July 28, 1875. Large parts of the address were omitted in the delivery. The statue (by Mr. Brock) represents Baxter with one hand lifted up as if preaching, the other resting on the Bible. On the pedestal of the statue is the following inscription: —

"Between the years 1641 and 1660
this town was the scene of the labours of
RICHARD BAXTER,
renowned equally for his Christian learning
and his pastoral fidelity.
In a stormy and divided age
he advocated unity and comprehension,
pointing the way to the Everlasting Rest.
Churchmen and Nonconformists
united to raise this memorial, A.D. 1875."

the head of *Words, not deeds* shall we not place the blind, disabled, immortal Milton? At the head of *Deeds, not words*, none can rival the dumb, inarticulate, confused, but all-powerful Oliver. Those who had *neither deeds nor words* — the foolish empty, ranting, canting partisans — was not their name "legion" both amongst Royalists and Roundheads? But for *deeds and words* together there is hardly any one that can stand comparison with Richard Baxter. It has been truly* said that he represented the spirit of the cnetury more than any other single man, both in its weakness and its strength. Look at him in court and camp — confronting with equal energy protector and king, demagogue and despot, wild enthusiast or worldly politician. Look at his labours for fourteen long years in this town. There are some three or four parishes in England which have been raised by their pastors to a national, almost a world-wide, fame. Of these the most conspicuous is Kidderminster, for Baxter without Kidderminster would have been but half of himself; and Kidderminster without Baxter would have had nothing but its carpets. You gave him the place from which he moved the English world. He gave to you the fame which on this day has attracted hither representatives from every class in England, and even from beyond the Atlantic.

What he was and how he dealt as he went in and out amongst you I leave to be related by one who knows him and all his time so well, that I am almost inclined to believe him to be that very contemporary come to life again whom Baxter is always describing as "the judicious† Dr. Stoughton;" one to whose kindly Nonconformist hands we gladly make over, by a singular reverse, that aspect of Baxter's career in which he was most emphatically a minister of the national Church — much in the same way as, in Dante's vision of paradise, Bonaventura, the Franciscan, rejoices to think that the praises of his founder, St. Francis, shall be sung by Thomas Aquinas, chief of the rival sect of the Dominicans.

Here, in Kidderminster, if nowhere else, his pulpit, his church, his portrait, his chair, his books, your invitation‡ to him, his farewell to you, will forever nourish the recollection that with you, as he said, "the pleasantest part of all his life in the ministry was passed;" because nowhere else were his spiritual successes so great; because you saw in him one who, as a distinguished contemporary* said, "feared no man's displeasure, and hoped for no man's preferment;" who exemplified in his own person one of his own farewell precepts — "He that will avoid doing evil must be taken up with doing good."

II. But I turn from his deeds, which belong especially to this place, to his words, which belong to all mankind; his words, so far as we can separate them from his deeds, when the one must be to the other as the thunder to the lightning. Think of his prodigious sermons — prodigious to read, how much more to hear, two or three hours long — think of that wonderful series of "several sermons" preached in Westminster Abbey "On the Vain Religion of the Formal Hypocrite." Look at his volumes — one hundred and fifty as some reckon, two hundred as others.† When Boswell asked Dr. Johnson which of Baxter's works he recommended to be read, that great old Churchman roared out, "Read any of them — they are all good." I have not followed, nor do I recommend you to follow, this advice; nor do I believe it. Baxter's works are not all good — nor is any of them good throughout. Even the "Saints' Rest" has only become readable by abridgment on abridgment. The "Reformed Liturgy," which he wrote in a fortnight, is a model of activity, but not of devotional style. In comparison with it, as Matthew Arnold says, even our old friend "Dearly beloved" can well stand its ground. There is something provokingly contentious in his objections to every scheme of worship or government except his own. Even the utmost "dissidence of dissent" would acknowledge that he must have been at times captious beyond endurance. His digressions and divisions are absolutely interminable. His mode of stating doctrines, though often generous and genial, is more often harsh and repulsive. He is filled with the most extravagant notions of his age on portents and on magic. His solutions of speculative difficulties are often like the medical receipts which he

* Hunt's "Religious Thought in England," i. 265.

† See the "Saints' Everlasting Rest," *passim*. This address was followed by an able and exhaustive account of Baxter's pastoral career by the Rev. Dr. Stoughton.

‡ This invitation to him and his still more interesting farewell have not been published. They were seen on this occasion through the kindness of the Rev. Thomas Hunter of Dr. Williams's Library.

* Robert Boyle (Orme, ii. 447).

† Burnet gives 200. But Grosart (in the annotated list appended to Baxter's "What Must I Do to be Saved?" p. 56) gives 159.

recommended from his pulpit to his flock. "Take three gallons of clarified whey, put in it two handfuls of balm, and as much frumity, and as much borage, boil it to two gallons, and put it in a stone pot of earth that hath a spigot at the bottom, and put into it a thin canvas bag, two ounces of lemon, an ounce of epithyme, an ounce of bruised aniseed, and a handful of groundivy (called alehoof)," etc., etc.* His learning, wide as it was, had little of that critical discrimination or profound research that renders even the errors of great scholars fruitful. "Read," he says, "the writings of our old solid divines, such as Perkins, Bolton, Dodd, Sibbs, and especially Doctor Preston; begin with the Assembly's 'Lesser Catechism,' then read the Greater, and next Master Ball's, and then Doctor Ames's 'Marrow of Divinity.'" † Alas! how few of these are now ever heard of, whilst Benedict Spinoza, who seemed to Baxter "a paltry fellow, not worth the naming," ‡ has achieved a universal fame, and veneration alike as a philosopher and as a saint. We can understand how Baxter looked forward to communion in the other world with the great saints of the Old and the New Testament — the heroes of early Christianity or of the Reformation — the patriots of his own time, Pym, Hampden, and Brooke.§ But we can hardly forbear a smile when we read that he also confidently relies on the delights of an eternal converse with "Zanchius, Pareus, Piscator, Camero, Whitelocke, Cartwright, Brightman, Dodd, Stukes, Bayne, Bradshaw, Bolton, Bell, Hildersham, Pemble, Twiss, Paston, Sibbs."

Yes — Bishop Burnet was right when he said that "Baxter meddled in too many things, and was, most unhappily, subtle and metaphysical in everything," with tedious subtlety and bad metaphysics. But it is this very tissue of contradictions of colour, of unprofitable stuff, through which — if I may draw a figure from the world-famous manufacture of Kidderminster — there run golden threads and solid strands, which redeem even the most obscure parts from ignominy, and at times are woven into patches and fringes of glorious splendour.

1. That same discerning contemporary whom I have just quoted observes that Baxter had "a very moving and pathetical way of writing, and was his whole life long a man of great zeal and much simplicity." It is this power that we now call "earnestness" which to the listening ear distinguishes even the most tiresome of his arguments from the sounding brass and tinkling cymbal of the rhetoric of many of his contemporaries. That often repeated saying of his, * which has become proverbial, that he preached "as a dying man to dying men," was in his case no mere figure of speech. Never was there a case where the spirit so triumphed over the feebleness of the flesh, as in that long conflict with "pleurisy, nephritic, and cholic," with the thirty-six doctors whom he invoked, and his own innumerable remedies; the "fourteen years of a languishing state when he had scarcely a waking hour free from pain; twenty several times near to death — in constant expectation of his final change; yet still not wholly disabled to God's service; his dull heart forced to more importunate requests, and with more rare discoveries of His mercy than he could have had in a more prosperous state." †

Even as a mere specimen of endurance and of indefatigable struggle against every kind of physical obstacle, Baxter's long painful existence is an example to us all. You, if there be any here, who are life-long invalids, or who, like our dear friend and pastor, Baxter's present successor, have been brought down to the gates of death, and returned through the long and wearisome ascent of slow and difficult recovery, should take courage from his example, and be convinced that in the way of doing the work of God even the feeblest of frames, and the most trying sicknesses, are not a fatal bar. "Weakness and pain helped me," he says, "to study how to die — that set me on studying how to live, and that on studying the doctrine from which I must fetch my motives or comforts. Beginning with necessities, I proceeded by degrees, and now," he says at the close of his life, "I am going to see that for which I have lived and studied." ‡

But this leads us to the thought of the permanent weight which is thus given to all his words; namely, that they are not the mere effusions of a man throwing off his speculations in the exuberance of health, but the expressions of a spirit which felt itself constantly, as he says, "at the door of eternity," "as it were with one foot in the grave — a man

* Baxter's Works, xvii. 280.
† Ibid. xxii. 335.
‡ Ibid. xv. 48, 64.
§ Ibid. xxii. 122.

* Orme, i. 151; also Baxter's "Poetical Fragments," p. 30.
† Works, xxii. 2, 3.
‡ Orme, i. 11.

that was betwixt living and dead." * "Whilst we wrangle here in the dark" — this was his constant thought — "we are dying and passing to that world which will decide all controversies; and the safest passage thither is by peaceable holiness." † It was this deep seriousness which gave a new *nerve* and force to his intellectual ardour. "I would as soon doubt the gospel verity," said Coleridge, "as I would doubt Baxter's veracity." It was this gave such a religious solemnity to his devouring insatiable appetite for truth in all its forms. "He that can see God in all things, and hath all his life sanctified by the love of God, will above all men value each particle of knowledge of which such holy ‡ use may be made, as we value every grain of gold." "Every degree of knowledge tendeth to more, and every known truth befriendeth others, and, like fire, tendeth to the spreading of our knowledge to all neighbour truths that are intelligible." "Look to all things, or to as many as possible. When half is unknown the other half is not half known." "Truth is so dear a friend, and He that sent it so much more dear, that whatever I suffer I dare not stifle or conceal it!" "As long as you are uncertain, profess yourselves uncertain; and if men condemn you for your ignorance when you are willing to know the truth, so will not God; but when you are certain, resolve in the strength of God, and hold fast whatever it costs you, even to the death — and never fear being losers by God, by His truth, or by fidelity in your duty." § That strain is indeed of a higher mood than the cant of the mere theological disputant. It is the strain of Luther or of Locke. It is the rebuke to the cowardly panics of our religious world; it is the rebuke to the cynical indifference of our scientific world; from one who, had he lived in our days, would, alike in the pulpit and the lecture-room, have opened upon us that consuming fire of his love for truth, which, as he says, "he could not keep secret to himself, shut up in his heart and bones."

2. But we have yet to ask what was the message which this ever-dying saint, this indomitable student, was specially empowered to deliver. It was that which has been inscribed on his monument. "In a stormy and divided age" — stormy with the storms of three revolutions, divided with the divisions of a hundred sects — "he advocated unity and comprehension." Many other thoughts abounded in that teeming brain, but they are more or less secondary. This one thought was primary and ever-recurring. Other messages of divine or human truth were delivered with more force and consistency by others of his time. But in the solemn proclamation of this message he stood pre-eminent. Milton and Jeremy Taylor in the eloquence of the "Areopagitica" and the "Liberty of Prophesying," Tillotson in his prudent and generous policy, Chillingworth and Cudworth in their philosophic arguments, promoted the same great cause of healing the divisions of Christendom and enlarging the borders of the national Church. But with Baxter this zeal for the unity of the spirit in the bond of peace, and in righteousness of life, was the fundamental dogma of his theology, the absorbing passion of his existence, mingling with all his combats in this world, and with all his meditations on the world to come. "In necessary things unity, in unnecessary things liberty, in all things charity." This famous maxim was dug out by Baxter from an obscure German treatise * and made almost

* "Poetical Fragments," Aug. 7, 1681. Works, xxii. 2.
† Orme, ii. 239.
‡ Works, xv. 207; xxiii. 440, 441.
§ Works, xv. 174, 184; xxiii. 441.

* Works xxii. 8; xxiii. 145. I subjoin the account of this treatise from Herzog's Cyclopædia, a reference which I owe to the kindness of Mr. Thomas Hunter.

"Rupertus Meldenius was a conciliatory theologian of the seventeenth century, of the particulars of whose life nothing can be ascertained; even his name has been considered a fictitious one. He is known only by one writing, *Paræneseis votiva pro pace ecclesiæ ad Theologos Augustanæ Confessionis.* As early as 1736, J. G. Pfeiffer, professor of theology in Leipzig, feared that the writing might be lost, and caused it to be printed in his *Miscellanea Theologica*, and from these Lücke has it in his work — 'Upon the age, the author, the original form, and proper sense of the ecclesiastical formula of concord, *In necessariis Unitas; in non necessariis Libertas; in utrisque Caritas*, Göttingen, 1850.'

"Lücke tries to determine the time of Meldenius, when he made it apparent from the *Paræneseis* that he was personally acquainted with John Arnd, and wrote this work between the twentieth and fortieth years of the seventeenth century. By means of the work *Stabilimentum Irenicum*, 1635, discovered in the Hamburg Library, in which some sentences of the *Paræneseis* are quoted, this conjecture of Lücke's is confirmed. As to the author we discover indeed nothing, still it mentions him as a well-known man, with no indication that the name was fictitious.

"Rupert Meldenius was a true exponent of the formula of concord; he does not think of a union of both churches; but in the midst of the troubles of the Thirty Years' War he longs for the inner peace of the Church, for a practical piety instead of the dry controversial theology of the schools. Nevertheless, he is far from all extravagance; he is healthy throughout, in that time a very rare phenomenon. The *Paræneseis* consists of two parts: in the first, the author describes shortly the position of the Lutheran Church, and in the second he presents the remedy. He charges the theologians that they do not properly distinguish between things necessary and unnecessary; one must be always prepared for combat, but one must not continuously strive. In order effectually to build up a church the minister must be in the holiness of his life blameless. Nothing is more to be dreaded than pharisaic hypocrisy, out of which proceed φιλόδοξια, φιλαργυρία, and

the motto of his life, and now it has gradually entered into universal literature, and been deemed worthy of no lesser name than that of the great Augustine, who, I fear with all his power and piety, never, or hardly ever, wrote anything so good or so wise as this. Listen to a few of the sayings in which Baxter carried out this maxim — "I tell you that if you use but true love and willingness in a diligent, reformed, pious, and righteous life, there is, certainly there is, saving faith and knowledge within." * "I will not be one that shall condemn or reject a lover of God and Christ and holiness for want of distinct particular knowledge, or words to utter it aright." "The least contested points are commonly the most weighty." †

Again and again, amidst all his own limitations and contradictions, he falls back on the Creed, the Lord's Prayer and the Decalogue, as the essentials and fundamentals of religion; and maintains that "no particular words in the world are essential to our religion; otherwise no man could be saved without the language those words belonged to." And even to the objection, so terrifying in his own age as in our own, that the breadth of this scheme would admit the Papist and the Socinian, he boldly replied, "So much the better, and so much the fitter it is to be the matter of our concord." ‡ "For myself," he says, "I will take no narrow name; I will be a Christian, a mere Christian, a Catholic Christian." That much abused word "Catholic" was to him the expression of his dearest convictions. He always uses it in its original sense of "universal," "comprehensive." It runs through the titles of his treatises, it forms the staple of his arguments. If it ever could be redeemed from its perverted use, it would have been by the persistent accuracy with which he was determined to employ it. In the last resort sin and moral evil were, in his judgment, the only grounds of division in Christendom — holiness and moral goodness the only grounds of union here or hereafter.

3. It was by no hasty or presumptuous partisanship that Baxter arrived at a Christian liberality so far beyond his age. In some respects it cut directly across the grain of his own combative dogmatism; across the current of his own impassioned earnestness. But he has enabled us to see the processes by which he reached these serener heights, and the process is even more instructive than the conclusions, — perhaps even congenial to some to whom the conclusions may be startling and offensive. It is now many years ago since on one of the few occasions when I had the pleasure of meeting the late Sir James Stephen, he recommended me, with his own peculiar solemnity, to read the last twenty-four pages of the first part of Baxter's "Narrative of his Own Life." * "Lose not a day in reading it," he said; "you will never repent of it." That very night I followed his advice, and I have ever since, publicly and privately, advised every theological student to do the same. It was a passage easy to be found, for, with a singular concurrence of favourable testimony, it was extracted as the very flower of Baxter's writings † in a well-

φιλονεικία. The chief faults of the theologian of the time the author describes in ten pages, and concludes with the exclamation, *Serva nos, Domine, alioquin perimus.* In contradistinction to these shortcomings, Rupert describes in the second part the contrary virtues, humility, contentment, love of peace, which the Christian must practise. A lack of love is the cause of all sorrow. Knowledge there is enough of, but love, the true salt, is deficient. One can scarcely believe that a minister, whose sins are forgiven by God, should not cover the faults in the writings of his colleagues with the mantle of love. *Omnium vero norma*, says Rupert, *sit caritas cum prudentia quâdam pia et humilitate non ficta conjuncta.* Rupert does not altogether reject controversial theology, but there must be connected with it a pious and thoughtful moderation. It is very much to be feared that one would rather lose than win the love of Christ in his heart by the transgression of moderation in the discernment of divine secrets. The old saying is familiar, *Nimium altercando amittitur veritas.* Then Rupert compares the former and present condition of Christendom, and concludes with saying, *Si nos servaremus in necessariis Unitatem; in non necessariis Libertatem; in utrisque Caritatem, optimo certe loco essent res nostræ. . . .* This writing, with its breath of genuine piety, appears in these days of ours, to have been soon forgotten without particular effect, but it remains to us as a monument that God, even in those dreary times, did not lack men who could have led in the right way, but that he found none to listen."

* Works, xv. 218; xvi. 336.

† Ibid. xxiii. 271.

‡ Narrative of his Own Life, p. 198.

* Book I., Part I., pp. 124–138. The passage has lately been republished in a separate form.

† In the fifth volume (p. 552–597) of "Ecclesiastical Biography; or, Lives of Eminent Men Connected with the History of Religion in England." By Christopher Wordsworth, D.D., late master of Trinity College, Cambridge, father of the present bishop of Lincoln and the present bishop of St. Andrew's, and brother of the poet. The interesting address of Bishop Charles Wordsworth to which I refer above was delivered in Kidderminster on August 22, 1862, on "The Reunion of the Church in Great Britain." The poet's opinion was communicated to the master's wife, and by her to her husband: — "Your brother says the most interesting part of your book is in Baxter's account of himself, — of which there is too little, — and the most dull and tedious is Philip Henry, of which there is too much. On the whole he is much pleased with your work. He and his sister have read it through." The master — as I learn from the bishop of St. Andrews, to whose kindness I owe these family reminiscences — when he was compiling his "Christian Institutes" for "Students in the Universities and the Junior Members of the several Learned and Liberal Professions," and "wished to insert in them the *best* and most comprehensive catechetical work he could find in the English language,"

known work by an eminent Churchman of the last generation — father of two gifted bishops, one of our own, the other of the Scottish Episcopal communion. From the latter of this episcopal pair, who once delivered an address in this place, full of admiration of your famous pastor, I have received a letter written by the poet Wordsworth, bearing his own unbiased witness to the extraordinary excellence of this extract: "The most interesting part," writes the poet to his learned brother, "of all the work is Baxter's account of himself."

The passage is indeed worthy of all these praises. It stands in the very foremost rank of autobiographical reflections; and I make bold to say that in permanent practical instruction it as much excels anything even in the "Confessions" of Augustine, as in ordinary fame it falls below them. It sums up the "soul-experiment" by which the venerable man, at the close of his eventful life, acquaints his readers "what change God had made upon his mind and heart since the unriper times of his youth, and where he had differed in judgment and disposition from his former self." The interest of this summary is not merely that it reiterates in every shape and form that desire for unity of which I have already spoken, but that it points out the various stages by which every serious student of human nature and of his own history may rise above the crude and narrow notions by which all men, especially perhaps all religious men, are exposed in their early or their less instructed years.

The substitution of solid for superficial knowledge; the sense of the uselessness of verbal controversy; the keen perception of the difference between essentials and non-essentials; the assurance that "the best doctrine and study is that which maketh men better and conduceth to render them happy;" the clear insight into the various gradations of certainty; the transition from morbid introspection of self to the contemplation of the Infinite goodness and wisdom; the growth of learning and experience that led him to distrust any exclusive authority, and to despise more and more the spirit of party; the power of "seeing more good and more evil in all men and in all churches than heretofore;" the acknowledgment that goodness, and goodness alone, whether amongst heathens or Christians, is the sole and the efficient condition of salvation; the growth of toleration even for those whom his own times and his own feelings led him most to suspect and fear; his increased horror of separation; his increased indifference to the approbation of men; his detestation of "selfishness" * — that new word which he and his Puritan friends appear to have coined for the express purpose of expressing their virtuous indignation against it — these are the seeds of great and fruitful thoughts which the training of a long life had sown in his own mind, and which, through his record of them, he has sown for all future generations. Read that touching narrative, my younger friends, for it contains the very warning which you all need, whether Churchman or Nonconformist, whether Radical, Liberal, or Conservative — for possibly you may be amongst those very characters that he elsewhere describes; as "young and raw, like young fruit, sour and harsh, addicted to pride of their own opinions, to self-conceitedness, turbulency, censoriousness, and temerity, and to engage themselves for a cause and party before they understood the matter." Read it, my older friends, for it is the very point at which we ought all to have reached, and which not to have reached is our bitter shame and condemnation: be amongst those whom he describes as "ancient and experienced Christians, that have tried the spirits and have seen which was of God and which of man; and noted the work of both in the world, like ripe fruit mellow and sweet." †

And neither in this immortal passage, nor elsewhere, does Baxter allow us to forget that these free and noble aspirations, these counsels of moderation ‡ and philosophical discrimination, are founded on those eternal principles of true religion, which of themselves banish and drive away a whole brood of errors on the right hand and on the left. What can be more complete than that reply to the vast herd of controversialists who use words without meaning and doctrines without defini-

made choice of Baxter's "Catechising of Families," "in preference to all others, after the fullest deliberation." I add a memorandum of the old Cambridge Churchman's favourite works, furnished by the same kind authority. "STANDING DISHES. (Theology). — Hooker, Taylor, Barrow, Butler, Leighton, *Baxter*. (Miscellaneous) Verse. — Shakespeare, Milton, Cowper, Burns, Wordsworth. Prose. — Bacon, Burke, Milton."

* The word occurs frequently in Baxter. For the novelty of its appearance see Archbishop Trench's "Study of Words."

† "Narrative of his own Life," Part II., p. 144, and "Farewell Letter" (unpublished).

‡ For the way in which "moderation" was the especial pride of the English Presbyterian party of that day, see Hunt's "Religious Thought in England," i. 410.

tion? "There is no confuting a man that saith nothing. Nonsense is unanswerable, if thou hast enough of it."* "O happy the world, happy the kingdoms, most happy the churches of Christ, if we could possibly bring men to know their ignorance."† "In a word, almost all the contentions of divines, the sects, the factions, the unreconciled feuds, the differences in religion, which have been the taunt of the devil and of his emissaries in the world, have come from pretended knowledge and taking uncertain for certain truths."‡ What a tissue of theological falsehood and frivolity could be rent to pieces if that hope were fulfilled! "When will the Lord persuade us not to be wise above that which is written; but to acknowledge that which is unrevealed to be beyond us; and that which is more darkly revealed to be more doubtful to us." "Being in sickness cast far from home, where I had no book but my Bible, I set to study the truth from thence, and so, by the blessing of God, discovered more in one week than I had in seventeen years' reading, hearing, and wrangling."§ What a healing, pacifying, invigorating influence is wrapt up in that title of one of his books: "Catholic Theology, plain, pure, and peaceable, for the pacification of the dogmatical word-warriors, who, by contending about things not revealed, or not understood, and by taking verbal differences for real, and their arbitrary notions for necessary sacred truths, deceive and deceiving by ambiguous unexplained words, have long been the shame of the Christian religion; . . . written chiefly for posterity, when sad experience has taught men to hate theological logical wars, and to love, sue, and care for peace."‖ What a new face would be put on our disputes, whether in private or public life, if we were to engrave on our hearts these aphorisms: — "Acquaint yourselves with healing truths; and labour to be as skilful in the work of pacifying and agreeing men, as most are in the work of dividing and disagreeing. Know it to be a part of your catholic work to be peacemakers, and therefore study how to do it as a workman that needeth not to be ashamed. I think most divines themselves in the world do study differences a hundred hours, for one hour that ever they study the healing of differences; and that is a shameful disproportion. Do not bend all your wits to find what more may be said against others, and to make the differences as wide as you can, but study as hard to find out men's agreements, and to reduce the differences to as narrow a compass as is possible. And to that end, be sure that you see the true state of the controversy, and distinguish all that is merely verbal from that which is material; and that which is but about methods and modes and circumstances from that which is about substantial truths; and that which is about the inferior truths, though weighty, from that which is about the essentials of Christianity. Be as industrious for peace among others, as if you smarted by it yourself; seek it, and beg it, and follow it, and take no nay. Make it the work of your lives. Lay the unity of the Church upon nothing but what is essential to the Church. Seek after as much truth, and purity, and perfection as you can, but not as necessary to the essence of the Church, or any member of it; nor to denominate and specify your faith and religion by. Tolerate no error or sin so far as not to seek the healing of it: but tolerate all error and sin consisting with Christian faith and charity, so far as not to unchristian and unchurch men for them. Own no man's errors or sins, but own every man that owneth Christ, and whom Christ will own, notwithstanding those errors and infirmities that he is guilty of. Bear with those that Christ will bear with; especially learn the master duty of self-denial, for it is self that is the greatest enemy to catholicism."*

And with this larger view of Christian communion, the whole horizon of Christian thought was enlarged also. When, a few years ago, the cause of theological inquiry pleaded for its life before the tribunals of our church and country, Baxter was one of the chief witnesses evoked from the past to bear his venerable testimony to the boundless wealth, variety and freedom of Biblical study.† The possibility of a religious man doubting some parts of the Old Testament without abandoning the New‡ — doubting even the New Testament without abandoning the fundamental principles of the Christian faith, was as clear to his mind as to some of the boldest thinkers of our own time — as clear

* Works, xvi. 474.
† Ibid. xv. 116.
‡ Ib. xv. 89.
§ Ib. xxii. 237; Orme ii. 46.
‖ Ibid. xvi. 367, 368.

* Works, xvi. 367, 368, comp. 282, 347, 393, 405, 436, 447; xv. 94.
† See "Defence of Dr. Rowland Williams before the Court of Arches," by Mr. Fitzjames Stephen in 1862, p. 128–133.
‡ Works, xv. 46, 60, 61, 73, 74.

as to that eminent scholar and philosopher, the most learned, the wisest, and the ablest of English bishops who has just been taken from amongst us.* However much at times his statements may have been darkened by the subtleties of his time, yet on the whole he maintained — against the scholastic, Lutheran, or Puritan view of "imputed righteousness" and "substitution" — the moral and spiritual doctrine of Christian redemption, as set forth in the Gospels and the Epistles, or in the most philosophic of German and English divines.† The confidence in the internal evidence of religion as alone sufficient, was as deeply rooted in his soul as in that of Coleridge, or Arnold, or Carlyle. "The melody of music is better known by hearing it than by reports of it. So there is a latent sense in us of the effects of the gospel in our own hearts which will ever cause us to love it and to hold it fast." ‡

Such was the teaching of the great pastor, and such was he himself — "Richard Baxter," (to use his own words) "who, by God's blessing on long and hard studies, hath learnt to know that he knoweth but little, and to suspend his judgment of uncertainties, and to take great, necessary, and certain things for the food of his faith and comfort and the measure of his church communion." § Even in his outward life he exemplified as few men else have ever done the confluence of all Christian influences. He was born of Puritan parents, yet converted by a book of Jesuit devotions. He was ordained in Anglican orders, offered an Anglican bishopric, the pastor of an Anglican parish, even a candidate, though an unsuccessful candidate, for a place in ‖ convocation; yet the oracle and patriarch of Evangelical Nonconformity, the friend of Calamy and Howe, of Hampden, and of Pym. Immersed as he was in the controversial theology of the Puritans, he was yet the zealous admirer of Richard Hooker, the most majestic of our divines, of George Herbert, the most saintly of our sacred poets — Herbert in whose "temple" he took refuge with the "sound of Aaron's ¶ bells from the jingling of scholastic philosophy;" — and he delighted in the converse of Tillotson and Tillotson's disciples and companions, whom the fanatics of his own and later times have so severely condemned as almost unworthy of the name of Christian. He is claimed as the first parent of the Society for the Propagation of the Gospel, the most venerable of the missionary societies of the Church; he is claimed also as the first parent of the extreme school **

* Bishop Thirlwall died on July 27, 1875.

† See Orme, ii. 42, 43, 55, 56, 130, with the hostile remarks of the editor.

‡ Hunt's "Religious Thought in England," i. 276, 464.

§ Works, xv. p. ii. ‖ Orme, i. 253; ii. 442.

¶ Orme i. 147. The whole passage is beautiful.

** See the bitter complaints of Orme, i. 327; and compare the like attacks of the non-jurors on the same divines.

* In connection with the relations of the Unitarians to Baxter, it may be interesting to insert the accompanying letters. The first is from the late lamented J. J. Taylor, who in his sermon on Nonconformity speaks of "Baxter, whom we are proud to claim as our spiritual progenitor." He had spoken to me in the same strain in 1868, and sent me as a proof his own well-worn copy of Arthur Young's "Baxteriana" with these words: —

"Young's introduction always struck me as singularly touching and beautiful. The chief defect in his selection is, that arranging his extracts under practical heads, he has no reference to the dates of the works whence they are taken. As Baxter's mind was pre-eminently a progressive one, growing in freedom and insight, and expanding in love to the very last, this total disregard to chronology in his compiler may have occasioned here and there an apparent, in some cases even a real, inconsistency between the tone and tendency of the different extracts. Nevertheless, with all the defects with which it can be reasonably charged, this little volume ever seemed to me full of spiritual wealth."

The second is from the Rev. James Martineau, in 1875. He writes as follows: —

"In his posthumous autobiography and review of his times, Baxter exhibits in his own person a large portion of the same change from dogmatic to moral and spiritual Christianity, which his influence bequeathed to the so-called 'Presbyterian' congregations. Without any indication of material doctrinal change in himself, his confessions abound in sentiments of the most comprehensive charity, and in words of longing for a union of Christians by a simplification of the terms of fellowship. When it was objected to him that his Church scheme would let in 'the Papist or the Socinian,' he replied, 'so much the better for concord;' adding that the proper way to deal with them, so far as they were wrong, was not to set up a test against them, and compel them to consolidate their error in institutions of their own, but to keep them at home and 'call them to account' by reasonable remonstrance, when they seemed to misrepresent the truth. For himself, he will take no narrow name; though he will say what he thinks on disputed points to any one that cares to know, and teach what he deems true to the people. But he will be 'a *Christian*, a *mere Christian*,' or, 'if that be not enough, a *Catholic Christian*.'

"This aversion to tests and creeds became universal and traditional among the 'English Presbyterians;' and, in the entire absence of any attempt at a Presbyterian order ecclesiastically, remained the sole distinction contrasting them with the Independents, who always retained the inner circle of the *Church* (*i.e.*, communicants admitted by examination) as distinct from the *congregation*. The open usage of the Presbyterians gradually led to variations of doctrinal opinions, Arminian, Arian, Unitarian in the modern sense; so that our spiritual ancestry is undoubtedly found in the Baxterian line, as our material possessions, chapels, grave-yards, endowments, are an inheritance of similar descent.

"I wish I could say that in departing from the theology of Baxter, we were faithful to the catholicity which has given us the power to change. But, on the emergence of Priestley's definite humanitarianism, the doctrinal interest came to the front; numbers of people began to come in from more dogmatic churches; societies for defence and propagation of a special theology were formed; congregations helped by them caught the infection of a narrow zeal, and, forgetting the old Baxterian hatred of party badges, thought it a point of

of Nonconformity which in Kidderminster possesses his pulpit, and which, in a wider sense, dating its spiritual lineage from his large and liberal spirit, has often, with whatever departure from his theology, lifted up before the churches the banner of tolerance and freedom that Baxter was among the first to unfurl. He was the champion, sometimes the almost solitary champion, of scrupulous consciences, in his gallant protests against what he deemed the imposition of unjust tests and burdens, whether against the Solemn League and Covenant* of the Church of Scotland, or against the too stringent enforcement of the Articles and Prayer-Book of the Church of England, yet still entreating his flock at Kidderminster and his disciples throughout the kingdom to avoid separation, to adhere to the national Church, to assist in its services, and to share in its communion. In all these multiplied aspects Baxter was a living proof that Churchmanship and nonconformity,† that breadth of thought and fervour of devotion, not only can co-exist in the same Church, but in the same individual.

And is not this noble monument a standing, speaking proof of the same great doctrine? Around his statue at this moment stand the representatives of the three great officials, who, without a sigh or a struggle, saw his expulsion from Kidderminster — the lord-lieutenant of the county, the bishop of the diocese, the vicar of the parish. Round the same statue are gathered also the representatives of the two camps of Nonconformists, so hostile to each other in the seventeenth century — in the language of Dryden, the Presbyterian "Wolf," and the Independent "Bear" — the representatives, let me rather say, of those diverging lines of saint-like men, who, through Priestley and Channing on the one side, through Watts and Doddridge on the other, have adorned the two opposite schools of Nonconforming opinion. And not only on a special occasion like this, but on the march of imperial and ecclesiastical legislation, which in this country are happily still undivided, his principles have left the trace of their enduring triumph. The galling subscriptions,‡ the excessive demand of uniformity, under which he and his brethren suffered, and but for which they would never have been parted from us, have been one and all, some of them within the last few years, swept away by an indignant Church and nation. The enlightened protests which he was almost the first to deliver against the fierce anathemas and the exclusive doctrines contained or implied in some passages of our formularies, have been endorsed by at least half of the clergy and almost all the episcopate.* The scheme which he proposed, of approved and tolerated churches, has been made the basis of our whole ecclesiastical polity. The interchange of social intercourse, which he sought to establish between the different classes of English Christians in Kidderminster and Worcestershire, is all but accomplished throughout the land.† The grand ideal of a national Church,‡ after which he panted as a hart panteth after the water-brooks, is now increasingly in the ascendant in the highest minds; and, unless intercepted by some unexpected and untoward catastrophe, will surely be accomplished — if not in the exact form which he suggested, yet in some form or other; if not in our days, yet in the days of our children. In his last hours, as in his full activity, he said, — and it was a speech pregnant in far-reaching consequences, the very seed of the Church of the Future, — "I would as willingly be a martyr for charity as for faith." "I would rather be a martyr for love than for any other article of the Christian creed."§

III. And this leads me to one final remark. We must not forget that he whom we now commemorate with such peaceful unanimity, in his lifetime lived in a whirl of discord and turmoil. Partly, no doubt, from his own eager polemics; partly and chiefly from the perpetual misunderstandings to which a character beyond his time is exposed. By Quakers he was attacked as a child of darkness; ‖ by Calvinists as

honour to assume the word '*Unitarian*' as an ecclesiastical name, and a merit to build up an organized 'Unitarian Church;' and, under these influences, we are fast losing the noblest feature of our historical position, and handing over the future to those who inherit a less freedom, but appreciate and exercise a greater."

* Orme, i. 138.

† See Orme, i. 82. ‡ Orme, ii. 242.

* Orme, i. 482–498.

† Orme, ii. 206.

‡ There is a touching passage, in which he expresses his hope that Richard Cromwell might accomplish this task, "who had been strangely kept from participating in the late bloody actions, that God might make him the healer of our breaches, and employ him in that temple work which David himself might not be honoured with, though he had it in his heart, because he had shed blood already, and made great wars (Works, xiv. 1, 2)." Contrast this with his editor's words. — Orme, ii. 229.

§ Baxter's Narrative, p. 364.

‖ In contrast to the Quakers of that day, a respected "Friend" of our own time, has told me that a member of the Society of Friends sent a copy of the "Saints' Rest" to the Duke of Wellington, which many years afterwards his son believed that he saw as

a fanatical Quaker; by Churchmen as a Socinian; * by Independents as a Papist; by Royalists as a traitor doomed to the very depths of hell.† All this is now past. The pamphlets of his assailants, his own rejoinders and counter-rejoinders, have sunk deeper than ever plummet sounded. The chaff of his life, the chaff of his writings is sifted and winnowed away; and the wheat, the pure wheat remains to be gathered into the eternal garner. It is a proof of his real goodness and eminence — it is a proof of what real goodness and eminence can achieve — that the noble memories of his character have survived and over-balanced the trivial, the distasteful, the acrimonious elements with which it was encompassed. The admiration of the best spirits of his own and future time has prevailed over the violence of petty faction and petty jealousy, and over his own contentious self. Sir Matthew Hale in his unfailing friendship; Lord William Russell in his dying testimony; Burnet in his grateful acknowledgments; Usher, when he entreated him to write the "Call to the Unconverted;" Eliot,‡ the apostle of the Indians, when he translated that book next after the Bible; Arthur Young, who, after a brilliant and stirring life, in old age and blindness, found his peace at last in the thought of Baxter's soul "reposing on the bosom of a Saviour's love" — all these turn out to be more correct judges, more prescient seers than the narrow partisans who saw in him a mere butt for scorn and slander, or a mere combatant of an opposite school. In this, our day, they have had an echo in the applauding voice of the most accomplished and the most eloquent of our living prelates, the most philosophical of our divines, the most genial and venerable of our clergy, whether Conforming or Nonconforming. His tall commanding figure, his gaunt features, by the art of the sculptor, are once more seen among us. They now recall something higher and more universal even than his efforts after union, or his struggles for liberty. He and his works have entered into that everlasting rest for which he so longed.§ He has taught us the way to that rest in words which rise above the jargon of all sects, and may strike a chord in the most philosophic, no less than in the most devout mind.* His uplifted hand calls to the unconverted, as of the seventeenth, so of the nineteenth, century, "to turn and live;" to turn † and live in accordance with the thousand voices of the Bible, of conscience, of good example, of nature; to turn from all our mean, degrading sins; from all our frivolity, self-indulgence, idleness, corruption, and party spirit; from that want of charity, and want of truth, and want of faith, which depress us all alike, upwards to the higher and more heavenly frame of heart, to the peculiar nobleness of spirit, which, as he truly says, distinguishes not only men from beasts, or the good from the bad, but the best of men from the mediocrity of their kind.

Not only in the turmoil of controversy, but in the toil and misery of daily life, in the restlessness of this restless age, his serene countenance tells us of that unseen, better world, where "there remaineth a rest for the people of God." It reminds us of that entire resignation wrung from his lips in those latest words: "Where Thou wilt, what Thou wilt, how Thou wilt." ‡ It reminds us of the high and humble hope that "after the rough and tempestuous day we shall at last have the quiet silent night — light and rest together; the quietness of the night without its darkness." §

A. P. STANLEY.

one of the three books on the table of the duke, by his camp-bed, at Walmer Castle.

* Works, xxii. 221.

† Orme, ii. 392, 375.

‡ Orme, ii. 101.

§ "Rest — how sweet a word is this to mine ears. Methinks the sound doth turn to substance, and having entered at the ear doth possess my brain, and thence descendeth down to my very heart; methinks I feel it stir and work, and that, through all my parts and powers, but with a various work on my various parts. To my wearied senses and languid spirits, it seems a quieting powerful opiate; to my dulled powers, it is spirit and life; to my dark eyes, it is both eyesalve and a prospective; to my taste, it is sweetness; to mine ears, it is melody; to my hands and feet, it is strength and nimbleness. Methinks I feel it digest, as it proceeds, and increase my active heat and moisture; and lying as a reviving cordial at my heart, from thence doth send forth lively spirits, which beat through all the pulses of my soul. Rest, not as the stone that rests upon the earth, nor as those clods of flesh shall rest in the grave — so our beasts must rest as well as we; nor such rest as the carnal world desireth. No, we have another rest from these — rest from sin, but not from worship — from sorrow, but not from solace." — Works, xxiii. 407.

* "A heart in heaven is the highest excellence of good spirits here, and the noblest part of the Christian disposition. As there is not only a difference between men and beasts, but also among men between the noble and the base; so there is also not only a common calling whereby a Christian differs from the world, but also a peculiar nobleness of spirit whereby the more exalted differs from the rest, especially in a higher and more heavenly frame of spirit. Other creatures have their faces to the earth; only man, of all inferior creatures, is made with a face directed heavenward. As the noblest of creatures, so the noblest of Christians, are they that are set most direct for heaven." — Works, xxiii. 224.

† See the striking passage at the close of the "Call to the Unconverted."

‡ Orme, i. 496.

§ Works, xxiii. 442.

From The Spectator.

THE CLOCKMAKERS OF THE SCHWARZWALD.

THE Baden State Railway, running in an unbroken line from the Rhine plain at Mannheim to the shores of the Boden See at Constance, forms two sides of that part of the Grand Duchy of Baden which in Germany is called Badischer Schwarzwald. Along this line go great numbers of English tourists hurrying to Switzerland, and rushing back again to England, but they seldom set foot in any part of this district, except in the town of Freiburg, a pleasant point to break a long and somewhat tedious journey. The dark hills thickly covered with pine-trees, which the traveller sees from the windows of his carriage, generally serve to remind him of the grander mountains he has left, or of the peaks which he hopes to climb. But among these hills is much picturesque and quaint scenery, of a character at once unique and distinct from that of countries more frequented by the traveller. From any high ground, lofty hills can be seen extending towards the horizon, more or less clothed with black pine-forests, broken here and there by the lighter foliage in the valleys, or by the open patches of cultivated land. There are cottage farms, with huge black and spreading roofs, better built, and showing signs of greater prosperity and comfort than in most mountainous districts. The village houses are less thickly grouped, and everything indicates an active and industrious people. In the valleys are many charming landscapes; the scale is small, but the perfect union of water and rock, of wood and meadow, produces harmonious and delightful pictures. Among the thick and fragrant woods the scenes are different, more weird and wild, but none the less attractive. Among these woods and hills dwell a people who unite the simplicity and kindness of the mountaineer and agriculturist with the shrewdness and energy of the artisan of the town. They cultivate their land with surprising care, and work at the manufacture of clocks and watches, glass and straw articles, with a diligence which has been rewarded by great success. They are so energetic and desirous of doing well in life, that like the men of the Canton Graubünden and the Oetzthal Alps, they willingly leave their own country and go away to England, America, or France, where they work hard, chiefly at clocks and watches. But to this desire for bettering their condition is united a strong love of home, so that in three or four years they come back with sufficient money to buy themselves a piece of land, on which for the rest of their days they live; they settle down, and their children will do as they have done.

The first thing which a stranger does at Furtwangen is to see the exhibition of the Gewerbevereins, and at Tryberg the Gewerbe Hall, open from May to October. The latter is a wooden building of some taste, where every variety of clock can be seen which the ingenuity of the Schwarzwalder can devise or his fingers execute. Round the walls and on the tables are clocks of every sort. Nearly all are of wood, though here and there is a fragile one of straw or ivory. The first which attracts attention is a very fine specimen of wood-carving; the figures and design are cut in lime-wood, and it stands two feet high. The fingers and hours are of ivory. The attendant puts it to two o'clock, and it forthwith plays a melodious air, as of the most delicate flutes. The next is still larger, and as the hour strikes a miniature band plays "*Der Wacht am Rhein.*" We pass on to one made of beach and walnut, the dark and light wood being charmingly blended. As the fingers touch the hour, two helmeted trumpeters step out and blow the reveille. Then there are cuckoos which strike up at the hour and thrushes who sing at the quarter, venerable monks standing beneath the belfry ring the hour when midnight comes. The automaton clock comes next, and we watch a sort of Pickwickian fat boy feed himself with rolls till three has finished striking. The taste and minuteness of the carving in the largest or the smallest point are very great; the regulator on the pendulum of the smallest clock represents, perhaps, an oak-leaf, or some simple, but still graceful object. Nor are more methodical and stronger-looking clocks wanting; they are of every kind; they will suit the kitchen or the boudoir. The excellence of the external work is equalled by that of the machinery, for having once gained a reputation, the inhabitants of these hills take care that it shall not be lost. The Gewerbeverein, or Union, guarantee the goodness of each clock which hangs on the walls.

Thirty years ago a really good little clock could have been bought for sixpence or eightpence, but now, with communication more easy, the small ones are sold for four or five shillings, the cheapest trumpeter for six pounds. Every workman has his special piece of work; one carves the figures, another prepares the

dial, a third the wheels, a fourth the pendulum, so that on one clock many hands are employed. Under this system, within a radius of sixty English miles, the number of clocks or watches turned out annually is nearly seven hundred thousand. Figures convey but small impressions to the mind, but if it is remembered that five thousand men are working at this trade, and that there are only about two thousand five hundred inhabitants in Furtwangen and fifteen hundred in Tryberg, it will be seen how strong a hold this trade has upon the people of the Schwarzwald.

It chanced that towards the end of the seventeenth century a family named Kreuz, more enterprising or clever than their neighbours, lived in the village of Neukirch. They made a rude clock, works and frame of wood, with a weight, and this was given or sold to the parish priest. This idea was not lost upon others of the enterprising Schwarzwalders, and the example was soon followed, and not long afterwards the farmhouses of the district began to be adorned with other wooden clocks. Two men were very apt at the work, they may almost be called the fathers of the art; their names were Lorenz Frei, called "the Woodworker," and Solomon Henniger, of St. Märgen. The germs now rapidly developed; the simple carving of wooden stands or frames gave place to the more elaborate work of ornamental clockmaking; the wood, the want of other occupations, the uncommon industry, acuteness, and union of the people, the freedom from political and other disturbing causes, all promoted this quick growth. Hawkers sold the clocks throughout Germany, and the Schwarzwald soon became celebrated throughout the empire.

The clocks were at first very simple in construction, wooden wheels and carved frames. It was not until between the years 1730 and 1740 that the first cuckoo clock — which is one of the class called *Spieluhren*, or clocks of amusement — was introduced, by Franz Ketterer, of Schönwald, a small hamlet on the hill above Tryberg, who is the real originator of the description of clock for which the Black Forest is most noted. This was novel enough for a time, but more minds set to work, and forty years later Anthony Duffner devised the first flute clock. Soon a real, noteworthy advance took place, in the introduction of the first pendulum clock. Then the fancy of one Kirner, a Schwarzwalder, who had become court painter to the king of Bavaria, suggested that very pleasant instrument, the trumpet clock. There were now five hundred persons engaged in the clock-trade in the Black Forest, and it had become the recognized occupation of the people. The work was all done by hand; not for some years was machinery used. But instead of the primitive fashion of each family working for themselves, masters and workmen began to appear; and as time went on, the change became more and more complete, till in 1849, the Grand Duke Leopold was asked to assist in founding a clock and watchmakers' school. The government of Baden at once acceded, and they gave ten thousand florins for the purpose of defraying some of the building expenses and to carry on the work of the institution — the community of Furtwangen gave wood and materials — and in 1850 the Clockmakers' School at Furtwangen was opened. Thus almost before the workmen of England had begun to think of technical schools, the peasants of a distant German province had already set one on foot. It has given new impetus to the work, and by the introduction of a special literature and instruction, in no small degree aided the general education of the people of this and the neighbouring villages, as well as the actual technical branch which it was created to improve. The school has two main objects. Firstly, the education of the young by literary and theoretical teaching in the elements on which the art of clockmaking is composed, that is, in the general principles common to any scientific manufacture, and in the more intricate details belonging specially to this one branch. Secondly, the improvement of the trade by a practical school or workshop, where the theories already taught can be carried out, where new improvements and methods can be tried, and where practical instruction can be given. Two important principles are acted upon in carrying out these aims, — the instruction is free, and it is not in the place of, but subsidiary to, and based on, that which is given in the *Folkschule*, or public elementary schools. This is important to notice, because there is too great a tendency in England to begin at the wrong end, not only in the lower branches of technical instruction, but also in those of a higher and more intellectual grade, and make technical supply the place of general teaching. Briefly put, these are some of the details connected with the school. The age of admittance is fourteen, and the pupil must have

passed through the *Folkschule*, a yearly examination, yearly distribution of prizes, a library containing technical and scientific books and models, and a period of study not confined to any particular time or length. The subjects taught are: (*a*) freehand and ornamental drawing; (*b*) arithmetic, geometry, and lineal drawing; (*c*) constructive drawing; (*d*) mechanics and natural science; (*e*) heads of German industry and mercantile business; (*f*) French, when possible.

There are a few minutiæ to notice as to the workshop. The most important are that the workers must bring their own tools, unless they can show satisfactorily that they are too poor to afford them, when they will obtain them freely at the shop. The government defrays the expense of living at Furtwangen of those also who would be unable to attend out of their own means. There are saw-mills and other appliances for doing the rougher work, preparatory to the more delicate details of the instructive workshop. Lastly, the whole is under the supervision of the government, through the minister of industry. The school and shop have both succeeded well, the trade increases every year, the prosperity of the people in an equal degree. As railways are extended, and the means of communication, not only with the immediate parts of Germany, but with the more distant countries of Europe and the world, become more easy, so undoubtedly will be seen a further extension of the business of the Schwarzwald.

It will be seen from these brief sketches that the wanderer in the Black Forest can not only receive pleasure from the charms of a peculiar and beautiful scenery, — he has also opportunities of studying some social features hardly to be found in more populous places. He finds — a long way from the great centres of commerce and manufactures — a simple and kind-hearted people, carrying on an ingenious trade quietly, yet actively, and keeping pace with modern improvements, for the peacefulness of the pine woods and the patriarchal simplicity of the villagers' lives seem to enable them to labour without the disturbing influences at work among so many industrial communities.

From The Saturday Review.

COUNTRY TOWNS.

THE remarkable likeness which exists between all country towns is perhaps due to the fact that in them there is none of the excitement and pressure which stimulates to change in cities. It may be urged by those whose love for one particular town of the class extends to all others, that there is really no more resemblance between them than there is between all members of the human race. It would probably, however, be nearer the truth to say that there is as much difference between country towns as there is between members of the same family. There are certain well-marked features which are common to all of them; there is, for instance, the market-place, paved with stones, whose roughness recalls memories of Alpine pine-wood paths, in the centre of which stands the town pump, with which in some cases an economical ingenuity has combined a lamp-post. Whether the object of this combination is that water should be in readiness at all times to put out the lamp, or that thirsty souls should never miss their way to the pump in the darkness of night, cannot be determined. On market days, or when some such extraordinary attraction as a cracked and incompetent German band offers itself, the market-place is filled by what is termed "a seething crowd," and on these occasions the vast superiority of the French or German over the English country town in point of picturesqueness is especially remarkable. The duller, or, as some would call it, the steadier, character of the English peasant finds expression in the monotony of his attire, of which the dingy whiteness or sombre mud colour is never relieved by a speck of brilliancy; and the crowd which the flat scarlet caps of some of the Swiss and German peasants, or the bright blouses of the French, would light up into liveliness, becomes a mere heavy mass. The market-place is generally overlooked by a church, which is to a cathedral what a hobbledehoy is to a grown man; and not far from this is the high street, upon which the whole building energy of the town seems to have expended itself, so that the word street applied to the other roadways of the place is a mere courtesy title. In the case of an assize town an abnormal importance is at the time of assizes assumed by the courts, which for the most part are stuffy narrow buildings, of which the ventilation and general arrangement rival in badness the law courts at Westminster. The com-

ing round of her Majesty's judges of assize throws a halo of glory and responsibility not only upon the court-house but upon all the officials connected with it. These indeed have been known to become so filled with a stern sense of duty as to refuse admission to the bench to a judge's marshal, who, on proclaiming his title, was informed that, "marshal or general it made no difference; he couldn't go on the bench without his lordship's permission." It is perhaps hardly fair, however, to speak of assize towns under the general heading of country towns; for to most of these there comes no such frequent diversion with the revolving months as is brought by the advent of judges, barristers, and their following.

To some of those which are not dignified by the periodical visits of the gown, arms, in the shape of the militia, bring an annual excitement which can hardly be called wholesome, depending as it does in one class upon the amount of flirtation, in another upon the amount of beer got through. Where there is neither militia nor assizes, there is probably a fair, which for the two or three days that it lasts completely upsets and demoralizes the aspect of the place. All these things, however, only disturb and change the ordinary current of life in a country town, as a "bore" does that of a river which it passes over; and it is to the every-day aspect of affairs that one must look for the characteristics of the place and its inhabitants. As there is a considerable likeness in the buildings of most country towns, so is there in the kind of people that they contain. It might indeed be supposed that the outer resulted from the inner resemblance, and that, as the sameness of national characters produces national types of face, so does the sameness of the internal life collected in small towns mark itself in external objects. There will always be found a magnate or two, who are at the periods of their residence to the populace of a small town what royalty is to that of a city. Next to these come they who, upon the strength of being on visiting terms with them, assume the position of the resident aristocracy, and who, with a due regard for their station, are so particular in their choice of acquaintance that they incur an infinite amount of dislike and contempt from the people whom they wish to inspire with the same reverence which they themselves entertain for the magnates. It is remarkable that this class pride and jealousy seldom extend to the tradespeople of country towns, whose manners and education are frequently far better than those of their fellows in London. The explanation of this is probably to be found in the fact that the business of each has often been handed down to him through a long line of ancestors, and that their dealings are almost exclusively with ladies and gentlemen. Another class who are generally found at their best in towns remote from the stir of cities are the old maids, of whose simplicity and single-heartedness Mrs. Gaskell writes with such admirable skill in "Cranford." On account of their position, unless they possess either wealth or rank, the so-called society of the place where they dwell is not kind to them — a fact which they seldom resent, but, accepting it as the natural and proper order of things, concentrate their energies upon the poor people of their districts, to whom their kindly presence and attention is invaluable. That they should spend much of their spare time in gossip is only natural; the human mind has a taste for excitement, and when there is none at hand provided by circumstance, is driven to make it for itself. Thus it is not surprising that to these good creatures the arrangement of a neighbour's tea-party, the meaning of the curate's attentions to the rector's daugther, or why Miss So-and-So wore pink ribbons instead of her usual blue at the horticultural show, become questions of absorbing interest. The afternoon visits and tea-parties at which matters of this importance are discussed, when fresh visitors keep dropping in, each with a fresh bundle of news, remind one somehow, perhaps by the fatuous excitement of the persons concerned, of the constant and aimless journeys to and fro which may be observed going on in a rabbit-warren. For the most part such gossips as these are, if trivial, harmless enough, and usually no great mischief results from the employment of putting two and two together and making five of them, which is their chief resource. If, however, one of the members of the society happens to be of a malignant disposition, she may by assiduous collection of tittle-tattle manage to construct a formidable scandal, just as by heaping together enough odds and ends of wood one may in time make a faggot.

In former days the bookseller's shop was the centre from which all news, social and personal, radiated. Any one anxious to diffuse a piece of information had only to visit this shop at a certain time of the day in order to be sure of finding a small crowd, all of whom were as anxious as were the Athenians for some new thing,

and each one of whom was desirous of being the first to give general currency to any novel statement. From the eagerness with which each picked up the story only to drop it elsewhere, it generally resulted that no one listened long enough to gain any accurate knowledge of the tale put forward; and thus, a variety of versions being spread, the original inventor's or adapter's object was thoroughly attained. In the bookseller's shop, also, the few men who were constituent parts of the population were accustomed to meet and interchange their ideas or what served them in their stead. But the facilities of obtaining books from London have greatly changed the position of the bookseller's shop in most country towns; where, from having served the purpose of a club, it has descended to occupying at best the position of a circulating library. In some cases the bookseller may also be the editor of the local paper, of which the principles sometimes illustrate strangely the boasted liberty of the English press. A visitor, for example, who was staying for some time in a small country town heard many complaints of a nuisance which a very little effort on the part of the authorities would have removed, and imagined that a paragraph in the local paper might be the best way of calling attention to this circumstance. On asking for the insertion of such a paragraph he was met with an awed and indignant refusal; the reason of which, elicited by severe cross-examination, was given in these words, spoken with a mixture of admiration for the daring of the suggestion and contempt for its ignorance: "Why! it would be censuring the police!"

The notion of the English emulating the Continental police by swooping upon the journal, suppressing it, and imprisoning its staff for sending forth such a paragraph, which would seem to be the origin of this reply, may have arisen from a laudable want of knowledge and consequent exaggeration of the powers and habits of the law's representatives. Where a policeman's province seldom extends beyond parading the streets in solemn dignity, he may well be invested with mystic and terrible attributes, as silent, stately Englishmen were wont to be by the Indian natives under their rule. And it is fair to observe that in the general run of small country towns the police have a remarkably easy time of it, and discharge their duties, which consist mainly in persuading drunken men to go home, and acting as peacemakers when a fight seems likely to set in, with excellent discretion. But it is also to be observed that the quietness which lends a charm to picturesque country towns on moonlit nights, when the outlines of buildings stand out clear against the far-off sky, is apt to be disturbed by sounds of revelry which would not be out of place in a London back slum. The country labourer's notion of enjoying himself does not often go far beyond beer, and when he has enjoyed himself for long, his temper is frequently fractious and his language invariably offensive. But for him, as for the powers of the press, the law has a mysterious terror; and, so long as there is a policeman within sight or reach, the disturbances of a small country town seldom go further than words.

From The Saturday Review.

CHARACTER CONNOISSEURS.

THE vulgar tendency to simulate a knowledge about things where the requisite conditions of accurate information are clearly wanting has ever been a theme for philosophic satire. It is the recognition of this tendency which has led the thinking few to despise the opinion of the many as a spurious and counterfeit kind of cognition. From Plato, who distinctly excluded mere opinion from the category of certain knowledge, to the modern idealist who pays no heed to the strongest assurances of common sense, philosophers have made light of prevailing convictions on the ground that they are formed in haste and with no due appreciation of the conditions of a rational certainty. Not only so, but science itself, which might be supposed to maintain a more amicable attitude towards prevailing belief, has long since learnt to imitate philosophy in its contempt for vulgar ideas; and a scientific lecture would now be deemed wanting in spirit and point if it failed to illustrate by some startling example the wide opposition between the habitual inferences of common minds and the verified conclusions of the savant.

Nowhere perhaps does popular belief exhibit its hastiness and inadequacy more conspicuously than in the readiness of most persons to pronounce an opinion respecting the characters and motives of others. The confidence with which many a man and woman will talk about the desires and habits of a comparatively new acquaintance must strike a reflective mind as a signal illustration of the eagerness of mankind to seem wise. There are many whose

modesty and good sense would prevent their giving an opinion on any point of scientific knowledge or æsthetic appreciation, who nevertheless feel no hesitation in passing judgment respecting matters of conduct of which their knowledge is infinitesimal. Numbers of people who do not in the least seem to be ashamed of ignorance respecting most matters of discussion, are quite sensitive as to their reputation for knowledge with respect to the intricacies of human character. When, for example, there is an addition to the society of a small town through the arrival of a new family, there is the greatest impatience to have a definite and fixed opinion respecting the idiosyncrasies of the new-comers. There will certainly be more than one knowing person whose supposed quickness of perception will at once enable them, satisfactorily to themselves, to define and characterize the man or woman about whom curiosity is naturally aroused. It is curious, too, to notice the readiness of others to accord to these persons the special faculty for intuition which they claim for themselves. It has often been remarked that the first condition of winning the confidence of others is to display a fair amount of self-confidence, and this truth is fully illustrated in the case of the people whom we are now considering. When a lady gives out among her acquaintance that she is an expert in matters of character and disposition, she speedily gains an enviable reputation for this kind of prescience. If there is any new character to be deciphered about which there hangs a certain mystery, she is the authority to whom all repair in order to acquire definite information. If a scandal is just germinating, and everybody is on tiptoe respecting its real nature and results, it is this connoisseur who is resorted to for a final solution of the problem. In this way people are sustained in the pleasing belief that they possess some easy avenue to the minds and hearts of their fellows, thanks to which they are enabled to dispense with the tardy methods of observation, comparison, and analysis, and to read a new character as confidently as an unfolded letter.

Yet it does not call for any remarkable powers of reflection to see that this intuitive kind of knowledge of others must be very delusive. For, first of all, human character is an exceedingly complex and variable thing, and cannot be known except after patient attention. The facile perusal of character of which we now speak always involves two inferences, either of which may be a mistaken one. In the first place, the self-styled observer argues that certain things which have held good of other people will hold good of the new character; and since it is exceedingly easy to mistake a quality of a certain order of minds for a universal attribute of mankind, there is always a chance of a wrong induction. In the next place, the observer is compelled to judge the whole of a character from a very few data; and here again there is ample room for error in reasoning that, because a person felt or acted so and so to-day, this must be his characteristic mode of feeling or acting. In other words, human nature is too variable, both as a whole, and within the limits of a single individual, to allow of the rapid kind of prevision of which we are speaking.

There is a second obstacle to this instantaneous reading of character which calls for special notice. Not only is character a phenomenon of great complexity, but it is also one in a high degree inaccessible. For, in the first place, all the thoughts and purposes of another have to be inferred from external signs; and this process, however carefully carried on, must always be liable to error. The real uniformities of connection between feeling and expression, for example, can only be known approximately after a wide and careful comparison of individual peculiarities. This reflection never occurs to the confident connoisseur of physiognomy, who fondly imagines that every moral peculiarity is distinctly indicated by some one form of facial structure or movement. In the second place, it should be remembered that all of us have a certain power of dissimulation, and most of us are accustomed to put some kind of watch on our words and actions. This is especially the case when we have to confront a new observer. We do not care, in most instances, to be conned too easily by our fellows. Nearly everybody is accustomed to some measure of reticence before strangers, while there are a few who, from a certain kind of pride and force of individuality, are wont even to mislead casual observers respecting their real aims and sentiments. Thus it happens that a person who is ready at a glance to classify any new variety of character runs the risk of accepting as an essential ingredient of the phenomenon something which is wholly adventitious. It may be said, of course, that the instances we have selected are exceptional ones, that the great majority of people are both too much alike and too transparent in their words and actions to occasion any serious difficulty to a skilful noter of men's natures and ways.

That there is a certain force in this consideration may be readily granted. At the same time, this fact does not alter the truth of our contention, that in every hasty judgment of character there is always an element of risk which forbids the process being described as an intuitive one. So, too, we may concede that a certain few possess an indisputable faculty of quick perception of the complexities of human character. Yet when we come to analyze this faculty, we find that it resolves itself into a happy skill in conjecture, which no doubt includes a certain range of past observation as well as a quickness of imaginative insight into other persons' feelings, but which nevertheless always remains what Plato would have called an empirical knack, wholly destitute of the exact certainty of scientific inference. Those who see in this conjectural skill a mysterious power of intuition are dazzled by the instances of correct prediction which they happen to have witnessed, and fail to take account of the errors to which this process is certain to lead.

It would probably be an interesting inquiry to trace out the various impulses in human nature which serve to sustain and foster this impatience in the observation of others. Some of the principal influences at work will readily suggest themselves to a thoughtful mind. It is obvious that the mere gratification of pride which attends all consciousness of knowledge, real or imaginary, will not account for the peculiar force of this tendency. That is to say, though it is true that the motive of vanity leads men to imagine that they are conversant with many matters of which they are in reality profoundly ignorant, it does not explain why they should be especially liable to assume this appearance of intelligence with respect to their fellows. It is evident that these special influences must be looked for in the peculiarities of the relations which people hold to one another. The following suggestions may perhaps roughly indicate the character of these influences. First of all, it is manifestly of practical importance to everybody to gain something like a definite opinion respecting those whom he has to meet in social intercourse. If, as some philosophers contend, the first motive of all inquiry is the need of a definite basis for action, we may understand how it is that most people are so eager to come to a decision respecting the dispositions of their acquaintances. Nothing is more embarrassing and annoying, for example, to a hospitably disposed lady than to have to do with a person whose tastes and ideas are shrouded in mystery. By the very painfulness of the situation she is driven to frame some hypothesis as to the person's real character, however little ground she may have for plausible conjecture. In this way people come to delude themselves that they have ascertained a man's real character, when they have simply been driven by the inconveniences of conscious ignorance to construct a purely hypothetical conception with regard to the object. Another influence at work in these cases is a form of the primitive fetichistic impulse to interpret everything outside one's own conscious life in terms of the same. The same tendency which accounts for the savage projecting his own feelings and intentions into tree or river accounts for people transferring their own modes of thought and sentiment to every new mind which comes under their notice. It is quite curious to remark the inveteracy of this habit, even after ample opportunity has been given for discovering the endless diversities of individual temperament. Possibly there is a charm to many persons in the spectacle of a mind retaining up to mature years the *naïve* belief that all the rest of the world must feel and act precisely as it does, and this æthestic consideration may serve still further to confirm the habit. People are encouraged in the cultivation of this mode of regarding others by the reflection that it is taken to indicate a singular innocence of nature and a touching unfitness to deal with the harsh intricacies and contradictions of human character. However this may be, the habit does prevail in many minds, and is a fruitful source of hasty inference and delusive misconception. May one not see illustrations of this tendency in the great liability of both men and women to delude themselves with respect to the characters which they chose for the matrimonial relation? It is not only the innocent girl who commits this error by fondly imagining in the absence of evidence that her lover must necessarily share her own pure thoughts; the highly cultivated man too may fall into it by taking for granted that the young woman whom he selects as his most intimate companion feels the same high aspirations that he himself feels.

The other influences which appear to favour this impatience of belief with respect to the characters of others are special emotional forces. The operation of feeling in sustaining assurance even when

there is the minimum of evidence has been a favourite theme of philosophers. There are two modes of this operation, according as the feeling predisposes to belief in any shape or favours some particular variety of conviction. Both of these modes may be illustrated in the class of beliefs of which we are now speaking. An example of the first is given us in the action of a love of power on our observation of others' characters. A readiness in unravelling the threads of human sentiment and purpose has always been looked on as a ground for self-gratulation and for the admiration of others. A man who thinks himself capable of divining instantaneously another's unspoken thoughts has not only the pleasing consciousness of power which every supposition of knowledge brings with it, but also a gratifying feeling of equality with this second person. That is to say, he thinks himself on a level with this other in respect to the knowledge of any thoughts or impulses which may occur to him. Not only so, but the assumption of this omniscient insight into character will pretty certainly inspire awe, if not dread, in many other minds, so that the man or woman who can make any pretensions to this fine penetration will be able to indulge in the most delicious emotions of power and superiority. A supposition so intensely gratifying as this must be will pretty certainly be secure from that close scrutiny and careful verification which alone would prove its validity.

The feelings which predispose men to entertain *à priori* a certain kind of notion respecting the character of others are too numerous to be dwelt on here. It may suffice to mention a few of them. There is the desire for sympathy, which is very strong in most minds, and which prompts a person to anticipate that every new character will respond in a kind of grateful resonance to his individual sentiments. Then there are the impulses of love and admiration which predispose the mind to believe in human goodness and render it optimistic in its conceptions of character. On the other hand, there are the less pleasing sentiments of distrust, hostility, and contempt, which sustain the conception that everybody is mean and ignoble till he has proved himself to be the contrary. These and other feelings always dispose their possessors to form certain opinions respecting any new character long before they have the necessary foundation for such opinions. To any one who will give himself the trouble of working out the many and complicated influences which tend to produce conviction respecting matters of character, quite apart from the force of evidence, it cannot be surprising that people's judgments on the ideas and motives of others are often so crude and inexact, and so little deserving to be called intuitions.

From Cope's Tobacco Plant.

AMBER.

AMBER is formed by the pith (*medulla*, or *marrow*) which flows from trees of the pine species, as gum flows from the cherry-trees and resin from pines. It is, first of all, a liquid which bursts forth in abundance; then it is congealed by the cold, or by the heat, or by the sea, when the great tides rise and sweep it from the islands. At all events, it is thrown on the coasts, and it seems to swim with the waves, and not go to the bottom. Our ancestors, thinking that it was the sap (*succus*) of a tree, called it, on that account, *succinum*. What proves that amber is the product of a species of pine, is that when rubbed it exhales an odour like that of the pine, and that when set on fire it burns after the fashion, and with the scent, of a resinous torch. It is conveyed by the Germans into Pannonia (Hungary) chiefly; thence the Veneti (Venetians), whom the Greeks called *Heneti*, who are in the immediate proximity to Pannonia, and who live round the Adriatic Sea, have brought it into vogue. The fable which has connected the Padus with amber has an evident cause. In our own day, the Transpadanian peasant women wear an amber necklace, for the sake of ornament, no doubt, but also as a remedy, forasmuch as amber is deemed good for affections of the tonsils and the fauces, these and the neighbouring parts of the body being subject to maladies produced by the different kinds of waters in the neighbourhood of the Alps. From Carnuntum, in Pannonia, to the coast of Germany, whence amber is brought, there are six hundred miles, a fact not known till recently. Still lives the Roman knight who was sent to procure amber by Julianus, superintendent of the gladiatorial games given by the emperor Nero. This knight travelled over the markets and the shores of the country, and brought back such an immense quantity of amber that the nets intended to protect the podium from the wild beasts were fastened with buttons of

amber. Adorned, likewise, with amber, were the arms, the biers, and the whole apparatus for a day. The largest piece the knight brought weighed thirteen pounds. It is certain that amber is also a growth of India. Archelaus, who reigned in Cappadocia, states that from that country (India) amber is brought in the crude state, and still adhering to the pine bark. It is polished by being sodden in the fat of a sucking pig. What proves that the amber first flows as a liquid is, that owing to its transparency different objects may be seen in the interior, such as ants, small flies, lizards. It is manifest that those objects got entangled in the amber when it was still in the liquid state, and that they remained imprisoned when the amber hardened. There are many kinds of amber; the white is that which has the sweetest scent; but neither the white nor the uncoloured is worth much. The deep yellow (*fulvus*, *tawny*, *fallow*) is the most esteemed. Though the transparency of the deep yellow amber is a recommendation, intense brilliancy is objectionable. To please there must be present, not fire but the resemblance of fire. The amber most in request is the Falernian, so called because it has the colour of Falernian wine. It is transparent, and has a softened splendour. Certain kinds attract by a tender shade, like the tint of boiled honey, but it ought to be known that any colour can be given to amber that is thought fit. A particular dye can be given to it by means of kid fat, or of the anchusa root; it can even be made to take a purple tinge. Moreover, when, by being rubbed in the hand, amber is enriched with an animating heat, it attracts straw, dry leaves, bast, just as the loadstone attracts iron. Bits of amber in oil burn with a brighter and more enduring flame than wicks of flax tow. Such is the excessive commercial value of this substance, that a small human effigy in amber is sold for a higher price than living and vigorous men. Verily, one censure (of such folly) is not enough. In the objects called Corinthian, copper mixed with silver and gold pleases; in carved objects the skill and genius of the artist delight. We have shown what recommends murrhines and crystals. Pearls are worn in the ears; gems on the fingers. In short, in all foolish superfluities there is either the satisfaction of vanity or there is real use; but as regards amber there is nothing to charm beyond the consciousness of possessing an article of luxury. Domitius Nero (the emperor), along with his numerous other absurdities, had given the name of amber to the hair of his wife Poppæa, and he had even celebrated the hair as amber in some verses; for fine names are never lacking for corporeal defects. From that moment amber was a third colour, much in request with the (Roman) ladies. Amber, however, is found to be of some value in medicine; but that is not the reason why women are fond of it. Worn as an amulet by children, amber is advantageous. According to Callistratus, whether taken in a drink or worn as an amulet, amber at all ages is medicinal in cases of madness and dysuria. This writer mentions a fresh variety, which is called chryselectrum, and which is (as the name indicates) of the colour of gold, and in the morning presents the most charming gradations of hue. For fire it has a signal hunger, and if it is near fire it catches flame and burns with immense celerity. This amber (if we may believe Callistratus) cures fever and other diseases, if it is worn on the neck; cures affections of the ear when ground and mixed with honey and oil of roses; cures dimness of sight, when mixed with Attic honey; cures affections of the stomach, either when taken in a powder alone, or drunk in water along with mastic. Moreover, amber can be efficiently and extensively employed in imitating translucid precious stones, especially amethysts; for, as we have said, it can be tinged of every colour. The pertinacity of certain authors forces us to speak, next of all, of lyncurium; for those who do not maintain that it is a kind of amber, yet, at least, declare that it is a precious stone. They affirm that lyncurium is the product of the urine of the lynx, but blended with a kind of earth, this animal (so these authors say) covering up his urine as if grudging the benefit man might derive from it; that it has the same tint as the fire-coloured amber, and can be carved; that it attracts not only leaves and straws but thin plates of brass and iron, which Theophrastus, giving credence to the statements of Diocles, believed.